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CANADIAN
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Morbidity Survey in the Municipal Doctor Areas in Manitoba*

May 1, 1938 to April 30, 1940

F. W. JACKSON, M.B., D.P.H.
Deputy Minister of Health and Public Welfare, Province of Manitoba

IN many parts of Western Canada over a period of the last twenty years, committees have been canvassing ways and means of providing themselves with medical services. Anxiety on the part of many residents in the west has been due to two factors: firstly, the scarcity of doctors practising in rural districts, and the distance some people have to travel to get medical attention; and, secondly, the high cost of medical care to rural people in the case of serious illness, particularly where the distances to be travelled are great. Out of many experiments, there has grown one definite system of providing medical care. This is known as "The Municipal Doctor Scheme." It has had its greatest impetus in the Province of Saskatchewan, and has extended in that province to considerable proportions. In the Province of Manitoba it has also become well established, particularly in those areas where ordinary medical care is not available.

With the possibility of a demand by certain groups of the public for some province-wide scheme of socialized medicine, the Department of Health and Public Welfare of Manitoba, with the approval of organized medicine, thought it highly desirable to institute some sort of study in selected municipal doctor areas in order to ascertain two things: firstly, the amount of medical care being asked for and received by people in these areas, and the amount of medical care which had to be obtained outside the area, and, secondly, the cost to the individuals for the services which they received.

A municipality in Western Canada is the local unit of government.

**Presented at the thirtieth annual meeting of the Canadian Public Health Association, held in Quebec City June 9-11, 1941.*

It consists of an area of from two hundred to three hundred square miles, with a population ranging from 1500 to 3000 persons. The municipal doctor, as the name implies, is a physician engaged by a municipality, or municipalities, or parts thereof, on a yearly salary basis to supply limited medical services to the residents of his area without charge to the individual residents. The money for this purpose is raised by a levy on all taxable property in the area. In the group of municipalities under study this levy costs the family on a quarter-section of land approximately $4.50 per year.

Over the course of the past twenty years the legislation in the Provinces of Saskatchewan and Manitoba in respect to the control of municipal doctors has become well stabilized; and the control in both these provinces rests, we believe, where it belongs, namely with the official Provincial Departments charged with the health activities within their respective jurisdictions.

Briefly, the jurisdiction in Manitoba allows any municipality to prepare a by-law in respect to engaging a municipal doctor. After it has been given first reading by the Council, it has to be submitted to the Department of Health and Public Welfare, together with a copy of the proposed contract the municipality intends to enter into with the physician, for the approval of the Minister. When approval has been given, the whole scheme can then be placed before the ratepayers for a vote, and the by-law declared carried, provided that three-fifths of the resident ratepayers voting thereon vote in favour of the by-law.

In our opinion departments of health are particularly interested in seeing that such a scheme of medical care grows in a logical manner, so that at some future date they will be assured that there will be no odd portions of the Province between municipal doctor areas which are without medical services. In Manitoba it was quickly found that the municipality as a unit of government was not, in most instances, the logical unit for the distribution of medical care. It was felt that not only the size of the area which a doctor could cover and the population he could serve had to be taken into consideration, but also other things, such as travel facilities, telephone connections, marketing centres, and the like. We believe we are correct in saying that most of Manitoba has now been dotted with what might be called "logical centres" from which medical care can be given—that is, places which are the natural centres of given communities; and we are trying to arrange our municipal doctor areas around these centres. This means that an area may sometimes take in parts of four or five different municipalities, and our legislation is prepared with this in view.

Any by-law which is passed to engage a municipal physician remains in force for a period of three years, and then is only repealed on a vote of the ratepayers. When it comes to consideration of the contract between the municipality and the doctor, all contracts in Manitoba now are made on a standard form in so far as general principles are concerned. The minimum salary paid in our Province is $3,250.00; the maximum is $4,500.00. In addition there are certain perquisites which increase to some considerable extent the money a municipal doctor makes. Over and above his salary he

is allowed to charge a reasonable fee for any dressings or drugs which he may dispense to a patient. He may charge to the patient a flat fee of $2.00 for the initial call in any given country case where, in his opinion, such call was unnecessary. He is also allowed to make charges for the extraction of teeth, the maximum being $1.00 per tooth. In addition, he has the right to charge regular medical fees for non-residents of the municipality who seek his services. He may also do insurance examinations and Workmen's Compensation Board work. Most of the municipal doctors inform us that the "extras" they make pretty well take care of the operating expenses of the practice; so that we may consider that the salary designated in the contract is a "net" salary in so far as the physician is concerned. Provision is made in the contract whereby the doctor shall have a two weeks' vacation period each year with pay, after one year's length of service, together with time off to attend district and provincial medical association meetings. Following every two years of service he is entitled to an extra two weeks' leave with pay provided the time is spent in taking post-graduate work. Protection against indiscriminate discharge of the doctor is provided for by the setting up of an independent board of arbitration to which the doctor may appeal if he thinks he is being unjustly discharged. The patient also has a right to bring complaints concerning the doctor's services to a committee of the municipal council engaging the physician.

As I have said before, with the advent of some public demand for socialized medicine, the Department of Health and Public Welfare of Manitoba thought it advisable to make a study in selected areas; and for this purpose a group of seven municipal doctor areas was selected in order that we would have a cross-section of all rural Manitoba in so far as nationality, population and economic well-being are concerned. These areas, shown in the map, were: (1) portion of the Rural Municipality of Argyle, (2) Rural Municipality of Cartier, (3) Rural Municipality of Daly and the Town of Rivers, (4) portion of the Rural Municipality of Grey, (5) Rural Municipality of Minto, (6) portion of the Rural Municipality of Saskatchewan and the Town of Rapid City and (7) Rural Municipality of Strathclair. Through the generosity of the International Health Division of the Rockefeller Foundation, and with the assistance provided by organized medicine in Manitoba, a two-year morbidity study in these areas was started May 1, 1938; and we wish now to present an outline of some of the material which has been obtained. The form used for gathering information was almost identical with the form being used during the same period by the City of Winnipeg for gaining information concerning medical care for persons in receipt of relief. This was done so that any statistics gathered in this morbidity study in rural areas might be compared with the statistics being gathered amongst our urban population.

Although the information gathered was tabulated according to the individual municipal doctor areas, we have, for the sake of simplicity in this report, combined the returns of all the seven districts so that each table gives the figures for the whole group under study. If further study of the material available indicates any great variance, because of racial origin, economic status or location of the area, a further report will be made.

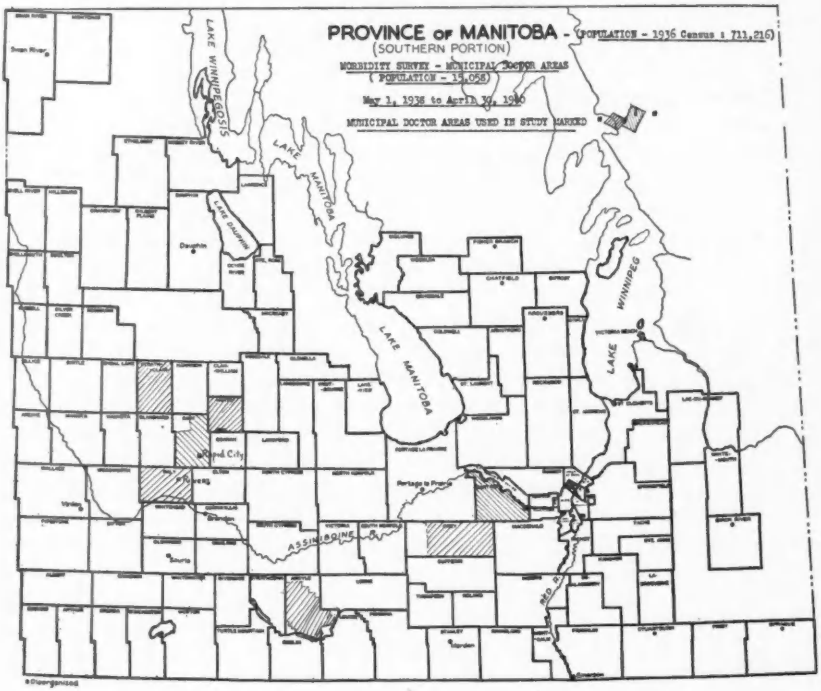

FIGURE 1

The seven Municipal Doctor Areas used in this study are indicated by shading.

Table I is a compilation of general statistics. It is interesting to note the high ratio of "office calls" to "house calls:"—*i.e.* nearly three to one. This, we believe, is as it should be; and from discussion with municipal physicians we gathered that people come to see their physician earlier in an illness when there are no direct individual monetary considerations. As a result, serious illness, which requires confinement in bed at home or in hospital, is lessened. Some of the hospital calls represent the initial trip of the doctor with the patient to the hospital, and possibly one subsequent visit. Generally speaking, most of the work in the hospital was done by the doctor residing in the place in which the hospital is situated.

We believe also that the mileage travelled by a municipal doctor is not as great as that travelled by the regular country practitioner. This, again, is likely due to the fact that the majority of patients are seen in the office of the doctor.

The "disability" we think is also interesting in that the average days per resident per year is 2.0 as compared with 5 days per person per year, which is generally considered the average for Canada.

It is interesting to note the comparatively small amount of hospitaliza-

tion required by this rural group. Whereas the average hospitalization required over the whole of the population of Manitoba is 1.5 days per person per year, it will be seen that the average in these municipal doctor areas is just one-third of this, namely .05 hospital days per person per year. Both these apparent lowered hospitalization and disability rates per resident should mean a definite economic saving to the individual and the community in which a municipal doctor operates.

TABLE I

MORBIDITY SURVEY, MUNICIPAL DOCTOR AREAS, MANITOBA
(Population 15,058)
May 1, 1938 to April 30, 1940

GENERAL STATISTICS

		Home or Office	Hospital	Totals
Number of cases		16,491	1,123	17,614
Days of disability		42,127	18,184	60,311
Days in hospital		.....	15,562	15,562
Mileage		56,070	36,434	92,504
House calls		8,917	.....	8,917
Office calls		22,519	.....	22,519
Hospital calls		.....	2,080	2,080
Operations:				
Major	Municipal Doctor	.....	123	
	Other physicians	.....	240	363
T. & A.	Municipal Doctor	132	62	
	Other physicians	.....	67	261
Minor		61	.....	61
Fractures	Municipal Doctor	300	27	
	Other physicians	.....	18	345
Maternity	Municipal Doctor	363	107	
	Other physicians	.....	64	534

NOTES

Average days of disability per sick person	3.42
Average days of disability per resident per year	2.0
Average days in hospital per sick person	13.87
Average days in hospital per resident per year	0.5
Permanent disability cases, not included in above averages	113

Table II shows the work done by municipal physician per 1000 population.

TABLE II

MORBIDITY SURVEY—MUNICIPAL DOCTOR AREAS, MANITOBA
(Population—15,058)
May 1, 1938 to April 30, 1940

SERVICES RENDERED PER 1,000 POPULATION PER YEAR

Number of patients treated	585
Number of office calls	744
Number of house calls	263
Mileage	3,072

Table III shows the hospitalization per 1000 population.

TABLE III

MORBIDITY SURVEY—MUNICIPAL DOCTOR AREAS, MANITOBA
(Population—15,058)
May 1, 1938 to April 30, 1940

HOSPITALIZATION AND DISABILITY PER 1,000 POPULATION, PER YEAR

Number of patients treated	37.3
Number of days in hospital	517
(Provincial average number of days in hospital)	1,500

TABLE IV

MORBIDITY SURVEY—MUNICIPAL DOCTOR AREAS, MANITOBA

(Population—15,058)

May 1, 1938 to April 30, 1940

SERVICES RENDERED BY DOCTORS OTHER THAN MUNICIPAL PHYSICIANS

Major operations	240
Fractures	18
Maternity cases	51
Abortions	11
Caesarean sections	2
X-rays	472
Cystoscopies	18
B. M. R's	11
Refractions	85
Special services	352
Electrocardiograms	6
Laboratory tests	1,703
Consultations	466
Tonsillectomies in hospital	67

As is to be expected, a general practitioner—and that is what the municipal physician is supposed to be—cannot give any group of people all the medical care which they may require. Table IV shows the services rendered by doctors other than municipal physicians. Naturally, it has been somewhat difficult to gather accurate information. However, hospital records, municipal office records, and the doctors' records have been canvassed, and we believe that we do show an accurate picture of what people in these districts received over and above the medical care which was provided by their own municipal physician.

TABLE V

MORBIDITY SURVEY, MUNICIPAL DOCTOR AREAS, MANITOBA

(Population—15,058)

May 1, 1938 to April 30, 1940

SPECIAL SERVICES—HOME

877 Laboratory (urinalysis)	3 Bones (osteomyelitis, epiphysis, periostitis)
897 Dental—attention and extractions	2 Duodenal and peptic ulcers
18 Optical	8 Stomach
X-RAY	23 Abdomen
21 Jaw and head	11 G. B. and Ba. Series
1 Neck	2 Pelvic organs
13 Shoulder girdle	7 K.U.B.
67 Chest	1 Varicose vein
1 (Abdomen or Chest)	2 Site not stated (neurasthenia)
14 Fleuroscope	
32 Hands, feet and wrists	1 B.M.R.
31 Upper limbs	3 Cystoscopy
14 Lower limbs	1 Electrocardiograph
9 Ribs	1 Planter wart
2 Hips	1 X-ray therapy
4 Spine	

TABLE VI

MORBIDITY SURVEY, MUNICIPAL DOCTOR AREAS, MANITOBA
(Population—15,058)

May 1, 1938 to April 30, 1940

SPECIAL SERVICES—HOSPITAL

1211	Urinalysis
183	Blood count
28	Blood matching
21	Blood urea
4	Blood chemistry and sugar
17	Blood (agglutination, sedimentation, hemoglobin)
3	Blood clotting
94	Culture, smear, swab and tissue examinations
19	Stool examinations
13	Cystoscopy
2	Urea clearance
1	Kidney function test
1	Phenolsulphonephalein test
6	Electrocardiogram
9	B.M.R.
3	Sigmoidoscope
11	Ba. enema
8	Gastric analysis
21	Sputum
3	Mantoux test
83	Wassermann
1	Lumbar puncture
1	Widal
2	Sensitivity test
2	Biopsy
10	Transfusions
58	Other laboratory
1	Elliot treatment—5½ hours
2	Diathermy (1) 2½ hours (1) 20½ hours
1	Radon seeds

X-RAY

9	Jaw and teeth
4	Sinuses and antrum
3	Mastoid
3	Skull
1	Breast
67	Chest
7	Fleuroscope
1	Hands and feet
9	Upper limbs
5	Long bones
28	Lower limbs
25	Stomach and abdomen
7	Kidney
17	K.U.B.
4	Pyelogram
6	Cervical vertebra
2	Pelvis
5	Spine
19	Ba. series
8	G.B. series
65	Deep X-ray treatments

TABLE VII

MORBIDITY SURVEY, MUNICIPAL DOCTOR AREAS, MANITOBA
(Population—15,058)

From May 1, 1938 to April 30, 1940

PRINCIPAL CAUSES OF ILLNESS—CASES PER 1000 PERSONS

Diseases of the digestive system	155
Accidents and other external violence	147.50
Diseases of the skin and cellular tissue	135.5
Diseases of the respiratory system	83
Rheumatic diseases and other general diseases	67.5
Other infectious diseases including venereal diseases (not specifically listed)	67.1
Heart and other circulatory diseases	64
Diseases of childbirth, pregnancy and the puerperal state	57.2
Diseases of the nervous system and other organs of special sense	51
Tonsillitis and sore throat	49.9
Diseases of the female genital organs and breast	41.4
Diseases of the kidney and genito-urinary system	35.1
Diseases of ear and mastoid process	30.9
Diseases of organs of vision	30.6
Diseases of the blood and blood-forming organs	20.7
Diseases of the bones and organs of locomotion	19.7
Cancer and other tumours	17.3
Measles	13.7
Pneumonia	7.9
Congenital malformations	7.8
Diphtheria, scarlet fever and typhoid	6.2
Tuberculosis—all forms	1.6
Chronic poisoning and intoxication	4.

One of the criticisms of the municipal doctor system in supplying medical service is that the people under this plan do not get as scientific a type of medical care as under the usual system; the assertion being made that the municipal physician does not take advantage of special diagnostic and treatment facilities available. In our opinion the data presented in tables V and VI refute this assertion and indicate that the municipal physician is giving a high type of medical service to his patients.

Table VII indicates the principal causes of illness, cases per 1000 persons. Tuberculosis and mental diseases are provincial responsibilities and so do not enter into the picture. As is to be expected in a farming community, accidents and minor injuries are two of the principal groups requiring medical care, particularly where there is no financial barrier between patient and doctor.

TABLE VIII

MORBIDITY SURVEY, MUNICIPAL DOCTOR AREAS, MANITOBA
(Population—15,058)

From May 1, 1938 to April 30, 1940

ILLNESSES BY AGE GROUP AND SEX

Age Group	Male	Female	Total
0—4 years	920	824	1,744
5— 9 "	689	663	1,352
10—14 "	636	631	1,267
15—19 "	731	947	1,678
20—24 "	784	1,004	1,788
25—29 "	723	868	1,591
30—39 "	1,136	1,275	2,411
40—49 "	988	1,023	2,011
50—59 "	912	770	1,682
60—69 "	638	485	1,123
70 and over	525	337	862
Not stated	35	32	67
1—no sex stated (19 years)			1
37—no age or sex stated			37
	8,717	8,859	17,614

Table VIII shows illness by age and sex. The main features to note are, firstly, how evenly sickness was divided as between male and female, and secondly, that outside the 0-4 age group most of the illness was in the working age groups. No doubt an "age grouping" of the whole population would possibly change the picture materially. However, with present available census returns this was not possible.

Table IX shows the illness per family. We believe it is generally recognized that certain families in a community may have a large percentage of sickness. This table shows that families with five or more illnesses during the two-year period, representing 19 per cent of the total families, accounted for 44 per cent of the total illnesses.

Over and above the ordinary medical care given by the municipal physicians to their residents, one would naturally expect that a municipal doctor

should make a fairly efficient medical officer of health because he would find it to his advantage to use to the fullest extent those methods now available for the prevention of disease. I believe that we are safe in assuming that in the municipalities where this type of service is in operation there are fairly complete immunization programs against both diphtheria and smallpox; and

TABLE IX

MORBIDITY SURVEY, MUNICIPAL DOCTOR AREAS, MANITOBA
(Population—15,058)

From May 1, 1938 to April 30, 1940

Number of Families	Illness per Family	Total Number of Illnesses
1	22	22
1	21	21
1	20	20
2	19	38
6	18	108
2	16	32
4	15	60
9	14	126
7	13	91
19	12	228
30	11	330
50	10	500
85	9	765
109	8	872
181	7	1,267
274	6	1,644
366	5	1,830
626	4	2,504
852	3	2,556
1,194	2	2,388
2,212	1	2,212
6,031		17,614

TABLE X

MORBIDITY SURVEY, MUNICIPAL DOCTOR AREAS, MANITOBA
(Population—15,058)

May 1, 1938 to April 30, 1940

MATERNAL AND INFANT CRUDE DEATHS AND RATES*

Number of live births reported in Survey	798
Number of maternal deaths	0
Maternal death rate	0
Provincial maternal death rate (Average for years 1938, 1939, 1940)	3.4
Number of infant deaths (under one year)	32
Infant death rate	40.2
Provincial infant death rate (Average for years 1938, 1939, 1940)	54.0
Total deaths	256
Crude death rate per 1,000 population	8.5
Crude Provincial death rate (Average for years 1938, 1939, 1940)	8.4

*Provincial statistics are tabulated by whole municipalities and this table is made accordingly, despite the fact that three of the municipal doctor areas do not cover all the municipality in which they are situated. This accounts for the difference in the figure for live births in this table and maternity cases in table I.

in most of these areas there is also fairly widespread immunization against scarlet fever. In the two-year period there were 3,767 vaccinations against smallpox, 3,136 immunizations against diphtheria, and 973 immunizations against scarlet fever. A recent study of diphtheria and smallpox immunizations in these areas indicates that over 30 per cent of the immunizations were in the age group 1-5 years, or amongst the pre-school group.

Although a two-year survey of 15,058 persons hardly justifies drawing any conclusions in respect to mortality rates, it is possible that some significant indications may appear. Table X gives a comparison of maternal, infant, and crude death rates in this study and for the province as a whole. It is again recognized that this comparison is not accurate as we have made no correction for variance in the age grouping of the groups compared.

TABLE XI

MORBIDITY SURVEY, MUNICIPAL DOCTOR AREAS, MANITOBA
(Population—15,058)

May 1, 1938 to April 30, 1940

TOTAL COST OF SERVICES RENDERED

	Total Cost	Per Person per Year
General Practitioner Service (Municipal Doctors' Salaries)	$ 53,200.00	$1.77
Services rendered by other Doctors (Surgery, etc. $42,996.00, plus 10% for possible missed cases)	47,295.00	1.57
Hospitalization—Public Ward (15,562 at $2.50–$39,130.00 plus 10% for possible missed cases)	43,043.00	1.42
	$143,538.00	$4.76

Table XI sets out the costs as we have been able to ascertain them. For services rendered by other doctors, the actual services rendered were tabulated and costs worked out, using the Workmen's Compensation Board schedule. In order to make sure that the sum allottted might be sufficient to carry the actual load, and to take care of the occasional possible missed cases, we have added an arbitrary sum of 10 per cent to the actual total.

In reference to hospitalization, the majority of rural people in the Province seek and obtain public ward hospitalization, and this is the type of accommodation provided for in our cost figures for hospitalization; but again, we have added to our hospitalization costs an arbitrary 10 per cent for possible missed cases. This means that for a population of 15,058 persons over a period of two years a fairly adequate medical and hospital service, without drugs, etc., can be provided for less than $150,000.00, which works out at less than $5.00 per person per year. One would not expect that this low figure would pertain if a complete medical service were provided; particularly if such things as surgery and specialists' services were on a fee basis.

The inferences drawn from the statistical material contained in this study are the author's only and it is conceded that it is quite justifiable to criticise

the figures quoted and the inferences made due to the absence of any adequate control area with which the municipal doctor districts may be compared. The comparisons as made, namely, the municipal doctor areas as against the the statistics for the Province or the Dominion (the only means of comparison at our disposal), leave a possibility of misinterpretation. This particularly applies to hospitalization and disability, the amount of medical services given, and also to the crude maternal and infant death rates.

One cannot conclude without bringing up certain points in respect to the whole question of State provision of medical care, which must receive very careful consideration. It is hard, in fact it is impossible, at the present time to estimate what people may demand in such a service; and if part or all of the service is rendered on a fee basis, adequate control is going to be very difficult. I make this statement in all good faith, as our records show that in one municipality in Manitoba, where general practitioners' services rendered are on a fee basis with a very low schedule of fees and with free choice of doctor, the yearly per caput cost is over $4.00 as compared with $1.77 where the doctor is on a salary basis.

A careful consideration of all the facts elicited by this study further convinces us that the services of the general practitioners for rural areas where there is only one doctor in a community can best and most economically be given by doctors on a salary basis, provided that the salary is adequate and the doctor and public are both properly safeguarded in the rendering of the service.

If the State provision of medical care should imply the placing of doctors on a salary basis, what are going to be the responsibilities of organized public health to see that such doctors are kept medically fit, and how will arrangements be made for intervals of post-graduate or extra-mural training? I believe that organized public health should take the leadership in this question of State provision of medical care, in order that we may ensure that any proposed scheme will be wholly interlocked with organized public health efforts. It is only in this way that we can ensure that stress, to an ever-increasing extent, will be placed on those aspects of medicine which have as their goal prevention of disease and the preservation of health.

Recent Advances in Tuberculosis Control in Ontario*

G. C. BRINK, M.B.
Director, Division of Tuberculosis Prevention, Department of Health of Ontario, Toronto

WHILE the Department of Health had been extending substantial assistance to municipalities in the province, particularly in respect to diagnosis since 1924, the control of tuberculosis had been generally looked upon as a more or less local problem. It is true that the Province contributed approximately one-third of the cost of maintaining indigent tuberculous patients in sanatoria but the initiative in the control of the disease and the cost thereof was largely left to the local municipality and the county.

Although in Ontario the number of sanatorium beds, as estimated by the accustomed measuring rod, had always compared favourably with the number in other provinces and the States of the Union, the mortality records showed that only 60 per cent of persons dying of pulmonary tuberculosis in Ontario in 1936 had had the benefit of sanatorium care. A follow-up of the records of the travelling chest clinics revealed that only 50 per cent of those persons discovered to have active tuberculosis and requiring sanatorium treatment had entered such an institution within one year of diagnosis.

This unsatisfactory state of affairs prompted the Department of Health to instigate an inquiry into the general tuberculosis situation as it existed in this province. This investigation, which was based on the experience of the years 1935 and 1936, was completed in 1937.

It was found that:

(1) The number of sanatorium beds was inadequate to meet the number of patients requiring admission.

(2) Many patients who had received maximum benefit from sanatorium care and who were not a danger to others were being maintained in sanatoria for unnecessarily long periods because there was no organized program of post-sanatorium care. Some of these patients were being retained for the sole reason that there were no pneumothorax refill facilities in proximity to their homes.

(3) There was a wide variation in the tuberculosis mortality rate in various sections of the province.

(4) There were marked differences in the cost of sanatorium treatment and incidence of hospitalization of the tuberculous among both urban and rural municipalities.

Further study revealed certain factors which it is believed were in great measure the cause of these differences:

*Presented at the forty-first annual meeting of the Canadian Tuberculosis Association, Toronto, June, 1941.

(a) There were many individuals unable to meet the expense of prolonged institutional care and, not wanting to become charges on their municipality, they either delayed or refused sanatorium treatment.

(b) Some municipalities could not bear the cost involved in maintaining their patients in sanatorium.

(c) Some municipal officials were refusing to recognize a person as eligible for sanatorium care until he met their interpretation of indigency.

(d) Some municipalities, whether from failure to recognize the necessity of protecting their residents or from apathy, evaded their implied or statutory obligations. The term of office of municipal councils in Ontario was one year. Undoubtedly the difficulty experienced in providing moneys for any prolonged program, the benefits of which would not be apparent probably for some years, entered into the picture.

(e) Approximately 8 per cent of the patients in sanatoria were able to pay their own maintenance and these included cases for which the Workmen's Compensation Board and Indian Affairs Branch were responsible.

A review of all the factors mentioned which were inhibiting the control of tuberculosis made it obvious that if a program of tuberculosis control were to be brought about which would be uniformly effective throughout the province, it must be on a broader basis than that of the local municipality. To accomplish this, the Government in 1938 passed an Amendment to The Sanatoria for Consumptives Act, abolishing the inequable and unsatisfactory system of maintenance charges by assuming the responsibility of payment of maintenance for indigent patients in sanatoria, formerly borne by the municipalities. Because the community was no longer burdened by sanatorium maintenance costs, the Government definitely fixed upon the local municipality its only financial responsibility, that of providing adequate post-sanatorium care for those of its residents who on discharge from sanatorium are unable to provide this care for themselves. The local municipality is entitled to recover from the county in which it is located one-half of any money expended for post-sanatorium care. There are 901 organized municipalities in Ontario, each having its own local board of health. Each municipality is now a post-sanatorium care centre and is in most instances concerned with relatively few patients.

This plan makes for more intimate contact between patient and local authorities and brings about a better appreciation on the part of the latter of their responsibilities.

Post-sanatorium care is defined as:

(a) Transportation from the sanatorium to the place of residence of the patient.

(b) Proper living accommodation, food, clothing and any other necessaries of life required by the patient; and

(c) Any special treatment for tuberculosis and transportation to and from any place at which such special treatment is available. (This refers particularly to transportation to and from pneumothorax refill centres.)

Upon notification by the sanatorium that a patient is ready for discharge

FIGURE I

Pneumothorax Treatment Centres in Ontario.

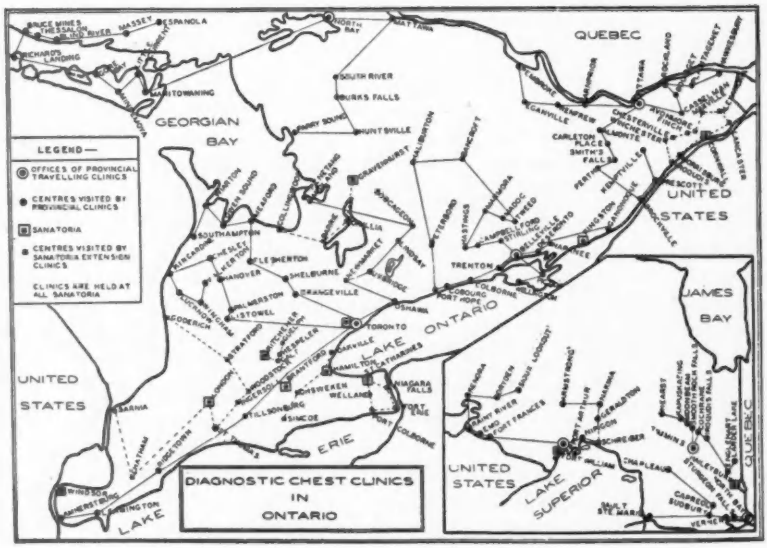

FIGURE II

Diagnostic Chest Clinics in Ontario.

and in need of post-sanatorium care, a municipality failing to make the necessary arrangements within thirty days is then liable under the Act to pay to the sanatorium the charges for maintenance of the patient until he is removed.

A major feature of the aftercare measures is that arrangements and payment for pneumothorax refills are included in the responsibilities of the municipality.

The Department, with the co-operation of local medical and hospital associations, arranged that in every section of the province physicians qualified to give pneumothorax refills were available to ex-patients of sanatoria and, where necessary, provided for post-graduate training to physicians chosen for this work. A prerequisite to Departmental approval of a physician to participate in this work on non-pay patients is the possession of or ready access to X-ray facilities. Some thirty new centres have been established, bringing the total to sixty.

The municipality is required to pay to the approved physician up to $3.00 per refill, the amount paid by the municipality depending upon the patient's contribution. Advantage has been taken of the authority given to the Department to reimburse municipalities for payments made to approved physicians on account of such treatments. Physicians are thus encouraged to undertake pneumothorax work by the assurance that they would secure a minimum of $3.00 per refill. This scheme has certain decided advantages, in that the physician who in too many cases had formerly done this work without remuneration is now paid, and it ensures the patient of regular treatments.

It should be observed that the Government, prior to the passing of the legislation just described, encouraged and facilitated the building of 550 additional sanatorium beds in 1938 by contributing approximately one-third of the capital outlay.

The Government has been fully alert to its obligations in respect to the control of tuberculosis of bovine origin. Compulsory pasteurization of all milk sold in urban municipalities was made effective in 1938. This measure has been gradually extended to all suburban and many rural areas, so that today 96 per cent of the entire milk supply of the Province is pasteurized.

The Department's co-operation with the general practitioner in the discovery of tuberculosis was further extended in 1938 by placing tuberculin for diagnostic purposes on the free list of biological products issued by the Department.

Legislation in 1939 gave the medical officers of health the power, with the approval of the Department, to require any person suspected of having tuberculous disease to submit to a medical examination of a specified type.

During the session of the Legislature in 1941 an amendment to the Act was passed, making provision for the obtaining by a medical officer of health or duly qualified medical practitioner, with the approval of the Minister of Health, an order from a magistrate to admit and detain in a sanatorium any person who (a) is suffering from pulmonary tuberculosis in an infectious state; (b) is unwilling or unable to conduct himself in such a manner as not to expose members of his family or other persons to danger of infection; or (c) refuses

to be admitted or to remain in a sanatorium or has left a sanatorium against the advice of the superintendent thereof.

The magistrate may order that such person be admitted to and detained in a sanatorium or in such other place as may be set aside with the approval of the Minister for the care of tuberculous persons, for such period not exceeding one year, as the magistrate may deem necessary.

Provision is also made for the segregation of any patient already confined to a sanatorium who is unwilling or unable to conduct himself in such a manner as not to expose other persons to infection or whose behaviour is detrimental to the recovery of other patients. The Act provides for the release by the Minister of any person who is no longer suffering from tuberculosis in an infectious state.

The expense of proceedings under this new section of the Act is to be paid out of provincial funds.

COMMENTS ON THE NEW POLICY

It is now almost three years since the inauguration of the new policy and it is fair to ask what have been the benefits. A comparison of the situation then and now will, is is thought, answer this question.

(a) A much shorter time now elapses between diagnosis and admission to sanatorium.

(b) The discharge of patients who have received maximum benefit from sanatorium treatment is no longer delayed by lack of adequate provision for post-sanatorium care or pneumothorax refill facilities.

(c) The percentage of patients entering sanatoria as re-admissions has decreased.

(d) In 1940 there was an increase of 197,062 or 18 per cent in treatment days as compared with 1937, and the number of patients treated rose from 5,659 in 1937 to 6,285 in 1940. Seventy-five per cent of the white population dying of pulmonary tuberculosis in 1939 had received treatment in sanatorium.

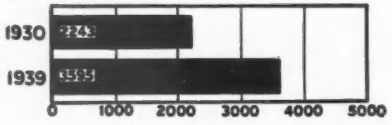

FIGURE III
Number of Sanatorium Beds in Ontario, 1930 and 1939.

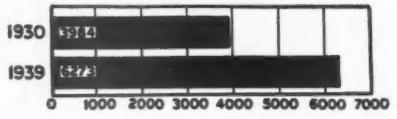

FIGURE IV
Number of Patients Treated in Sanatoria in Ontario, 1930 and 1939.

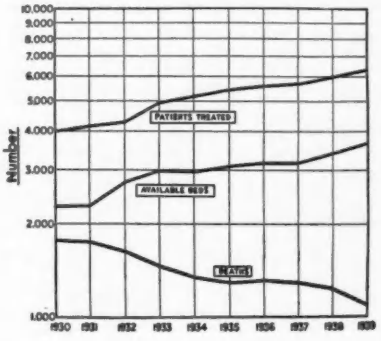

FIGURE V
Available Beds, Patients Treated, and Tuberculosis Deaths, Ontario, 1930-1939.

Table I shows the amounts which certain counties, cities and separated towns formerly paid and what they would have been paying had they undertaken under the old Act the hospitalization responsibility as now performed by the Government.

TABLE I

MAINTENANCE OF PATIENTS IN SANATORIA

Municipality	Average Expense to Municipality 1935—1936	Expense Assumed by the Province 1940
*County of Carleton	$ 6,651	$ 15,182
*County of Frontenac	110	5,784
*County of Peterborough	2,679	10,503
*County of Renfrew	5,226	22,551
*Counties of Stormont, Dundas and Glengarry	22,264	68,231
City of Toronto	400,764	374,540
City of Kingston	9,017	19,530
City of Peterborough	6,140	17,273
City of North Bay	3,905	10,579
City of Belleville	2,145	5,140
Town of Brockville	1,767	5,493

*Excludes Cities and Separated Towns.

(e) Patients in sanatoria are now relieved to a large extent of the financial worry associated with their treatment, as the present system permits a patient to retain certain assets in order that he may be better able to rehabilitate himself following discharge. A patient who is able to contribute toward his maintenance without undue hardship is expected to do so. In this connection, however, it might be noted that over 86 per cent of all patients in sanatoria make no contribution toward their own maintenance.

(f) No section of the province is now handicapped in hospitalizing its patients because of its financial inability or reluctance to meet the expense. Hence the opportunity of sanatorium care for tuberculous patients is now enjoyed equally by every part of the province. The expense of sanatorium treatment is spread uniformly throughout the province.

(g) Following on the new scheme it became apparent that, since the Government was contributing over 90 per cent of the operating revenue, some acceptable form of medical inspection would be required. Two visits to each sanatorium have been made, during which a review of the records, including the X-ray films of all cases in residence and all cases entering and leaving the sanatorium between visits, was carried out. A card giving rather detailed information was completed in each case, and filed in the Division of Tuberculosis Prevention. Problems were discussed with the medical superintendent of each sanatorium and a report was forwarded to him following each visit.

Additional responsibility in the matter of accounting was placed on the Division. The financial and annual medical reports of sanatoria previously afforded no common basis by which comparison of costs for similar services could be made. This year, the Division, with the co-operation of the sanatoria, initiated a uniform system of accounting and medical statistics, which it is hoped will be of value both to the sanatoria and the Department.

(h) Municipal officials and the public are now showing more interest in the tuberculosis problem than ever before.

It is presumed that the following statistical data will be of interest. In 1940 it is estimated that:

(1) The cities, towns, villages and townships were saved approximately $1,634,000 in sanatorium maintenance costs and since July 1st, 1938, to December 31st, 1940, the saving has been well over $4,000,000.

(2) The number of ex-patients of sanatoria receiving post-sanatorium care (exclusive of pneumothorax refills) was:

	Number	Cost
By cities	720	$ 90,620
By other municipalities including separated towns	393	39,034
By Ontario Department of Health	131	18,917
	1,244	$148,671

(3) Indigent or semi-indigent ex-patients of sanatoria receiving pneumothorax refills number 1,040; municipalities represented, 214; cost to the Department, $44,537.

(4) The total amount of tuberculin distributed was 12,107 cc. and the cost of tuberculin to the Department was $2,670. Tuberculin was issued to some 800 physicians, 110 hospitals, 26 non-Departmental clinics, 9 sanatoria, 10 municipalities for secondary school surveys, and 2 universities.

CONCLUSION

The Ontario program has been designed around three fundamental principles, namely: (1) removal of all financial obstacles retarding the admission to and treatment of tuberculosis in sanatoria; (2) an organized and enforceable system of post-sanatorium care that permits the earlier discharge of maximum benefit cases and provides protection against reactivation or breakdown; and (3) more co-ordination of all anti-tuberculosis activities.

Such advances as have been made in the control of tuberculosis in Ontario are in a large part due to the splendid co-operation of the Boards of the various sanatoria, along with the medical superintendents and their staffs. Ontario sanatoria are self-governing and form the real background of any prevention program.

One must also mention those physicians who so generously give their time and efforts in the various diagnostic and refill clinics throughout the Province.

The New Immunization Program in the Royal Canadian Air Force

A. H. SELLERS
Flight Lieutenant, R.C.A.F., Medical Branch

ON June 23, 1941, the Air Council approved a program which involves the Schick and Dick testing and subsequent immunization of all Air Force personnel throughout Canada and Newfoundland. Three days later the complete plan went into effect. This comprehensive preventive program is a significant progressive step, calculated to reduce the risk of diphtheria to insignificance and to apply the most effective available measure in the control of scarlet fever.

The major responsibility of a medical officer in the R.C.A.F. is maintenance of the health of personnel at a high level and reduction of disease to a minimum. The very nature of the British Commonwealth Air Training Plan with its long period of intensive training makes imperative the preservation of physical fitness among trainees. The Directorate of Medical Services (Air) recognized early the need for applying all measures for the effective control of communicable disease which would reduce non-effectiveness due to sickness and expedite training. This principle has guided the evolution of the present communicable disease control program.

The British Commonwealth Air Training Plan involves many movements of personnel during the several stages of training. The constant, widespread movement of drafts adds to the problem of local control in diphtheria and scarlet fever, the risk of spreading infection by carriers from station to station and to the civilian population A trainee pilot, for example, proceeds from an "M" Depot to Initial Training School and thence to an Elementary Flying Training School and Service Flying Training School before graduation and posting overseas. Such movements may traverse several provinces, and, as a result, the problems of communicable disease control are more difficult than in civil life or in the Army where there is a basic unit stability.

The training of Air Force personnel is a pressing and expensive business. In the ordinary course of events, for example, six to seven months are required to complete aircrew training. The Medical Branch is vitally concerned, therefore, with avoiding loss of training time. This it seeks to achieve by keeping at a minimum non-effectiveness due to ordinary sickness, by limiting the spread of disease, and by reducing the need for interference with movement of personnel from school to school or overseas by the application of quarantine measures.

The health of personnel of the British Commonwealth Air Training Plan has continued to be maintained at a high level but outbreaks of diphtheria and scarlet fever during the winter and spring of 1940-41 caused sufficient

sickness and loss of time to justify the introduction of procedures promising an effective measure of future control.

The need for immunization against diphtheria and scarlet fever was early made clear by evidence of a higher group susceptibility in the Service than had been previously suspected. This evidence was provided principally by the results of Schick and Dick tests done on large groups of trainees during outbreaks of diphtheria and scarlet fever in the Service in the past winter. The findings have been of value not only to the Service but to the civil authorities at large. The figures for four series of tests are given in table I.

TABLE I

FINDINGS IN SCHICK AND DICK TESTING IN R.C.A.F. PERSONNEL

Schick Reading	SCHOOL A		SCHOOL B	
	Number	Per Cent	Number	Per Cent
Negative	598	26.6	1,011	18.8
Positive* 2nd day	922	41.1	2,766	51.4
Positive* 6th day	247	11.0	240	4.5
Sensitive	479	21.3	1,360	25.3
TOTAL	2,246	100.0	5,377	100.0
	SCHOOL C		SCHOOL D	
Dick Reading	Number	Per Cent	Number	Per Cent
Negative	2,987	70.9	546	85.3
Positive	1,228	29.1	94	14.7
TOTAL	4,215	100.0	640	100.0

*All negatives re-read on 6th day.

These and other statistics have shown that more than 50 per cent of personnel are susceptible to diphtheria on entering the Service. Figures for scarlet fever vary widely but exceed 25 per cent on the average.

The risk of diphtheria in the Service is therefore quite real. Moreover, graduates of the British Commonwealth Air Training Plan proceeding overseas will be exposed to an environment in which diphtheria is much more prevalent than in Canada. The immunization of personnel during the training period is the appropriate step. By this procedure, at small cost, almost complete elimination of diphtheria can be expected.

It is recalled that during the five years before diphtheria toxoid came into general use, there were over 1,600 deaths from diphtheria annually in Canada, one tenth of which were among persons 15 years of age and over. During the same period an average of over 11,000 cases of diphtheria were reported each year, almost one fifth of which were in persons 15 years of age and over.

Diphtheria has ceased to become a significant problem in communities in which one third or more of the susceptibles have been immunized. Carefully controlled studies have shown that a reduction in diphtheria incidence of 90 per cent or over can be achieved by the administration of diphtheria toxoid (1) (2) (3). The experience of larger cities, such as Hamilton and Toronto,

has shown also that control of cases by immunization of susceptibles controls the spread of infection. The evidence for this statement lies not only in the reduction of cases and deaths from the disease but in the decline in the number of positive throat swabs despite an increasingly careful search.

In scarlet fever the ground is not so certain, but immunization is the best known weapon of control available and there is considerable evidence that a substantial reduction in incidence can be effected by such immunization (4) (5). Scarlet fever, while not in itself a severe disease in Canada, is particularly serious by reason of the high incidence of complications and the prolonged periods of isolation and convalescence required.

THE PROGRAM

The new R.C.A.F. program calls for the Schick and Dick testing of all personnel either in or entering the Service. The Schick test is read at 24-48 hours and if negative it is read again at 5-7 days. All Schick positives (first or second reading) are given two 1 cc. doses of alum precipitated diphtheria toxoid subcutaneously at a four-week interval. Schick sensitives are not given any toxoid.

The Dick test is read at 22-24 hours and all Dick positives are given a series of five 1 cc. injections of scarlet fever toxin subcutaneously at weekly intervals in graded doses.

To implement this program on larger stations, especially those of initial entry ("M" Depots) where several hundred tests and inoculations have to be done daily, special clinics with trained personnel have been set up. On smaller stations the volume of tests and inoculations is small enough that the station medical officer can handle them effectively.

Records of all tests and inoculations are made on a card designed for the purpose. This card is reproduced in figure I.

NAME			NUMBER		
VACCINATION	DATE	NO TAKE	PRIMARY TAKE	EARLY REACTION	VACCINOID REACTION
DICK TEST	DATE	POSITIVE		NEGATIVE	
S.F. TOXIN	DATE	DATE	DATE	DATE	DATE
SCHICK TEST	DATE	POSITIVE	NEG. 1	NEG. 2	SENSITIVE
DIPHTHERIA TOXOID	DATE		DATE		
T. A. B. T.	DATE		DATE		DATE
REMARKS					

Figure 1
R. C. A. F. IMMUNIZATION RECORD CARD

This card is retained by the unit until the individual concerned is posted elsewhere, and if immunization is not complete at time of posting, the card is passed to the next station or unit, where the record is carried to completion. A permanent record of all tests and inoculations is made on the medical history sheet of each individual and when immunization is complete, the cards, having served their purpose, are transmitted to Air Force Headquarters to be used for statistical purposes.

COMMENTS

It is recognized that diphtheria and scarlet fever are not the only diseases, outbreaks of which may disturb the training program or increase non-effectiveness, disability and death due to sickness. These two diseases, however, are ones against which individual protection may be achieved by available specific immunization procedures and both diseases are much more easily controlled by such immunization than by dealing with cases as they arise. Consequently, specific immunization of all Service personnel offers a specially important and desirable control measure.

It is not expected that specific immunization will eliminate diphtheria and scarlet fever from the Service. Scientific experience and expert opinion agree, however, that such a measure is the most effective known weapon of control. The introduction of the new R.C.A.F. immunization program is regarded as an important contribution to the Service.

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Report of an Outbreak of Trichinosis*

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MORE than two thousand years ago, when Moses was dictator to the children of Israel, and was, in addition, chief officer of health, he issued the following ordinance: "And the swine is unclean to you. Of their flesh shall ye not eat, and their carcass shall ye not touch." His reason for believing that pork was not fit food for Israelites is not on record, but it is altogether likely that he had noticed the frequency with which illness may have followed the ingestion of that article of diet. Mohammed, in the seventh century A.D., followed the example of Moses, and, as a result, many millions of this earth's inhabitants, if they adhere rigidly to the tenets of their religious belief, are spared the disagreeable experience of contracting trichinosis, a disease which over the centuries must have been common, even though it was not recognized until about the middle of the nineteenth century.

Sir James Paget, in 1835, while performing an autopsy, noticed that calcareous nodules in the cadaver were dulling his scalpel. He had some of these nodules examined by means of one of the rather simple microscopes of his day, and recognized in them a worm within a capsule. Later in the same year, Robert Owen of the College of Surgeons examined these nodules and named the worm *Trichina spiralis*. Bowditch, of Boston, in 1842, reported the first case of trichinosis in America. Zenker, of Dresden, in 1860, described clinical trichinosis as it occurred in Germany. With characteristic thoroughness, the Government of Prussia built up a system of inspection of pork in abbatoirs, which in 1895 required the services of 27,000 persons. Nevertheless, trichinosis persisted, for not all citizens could be persuaded to thoroughly cook their pork. Swine form the reservoir of infection, deriving it usually from the ingestion of raw pork clippings in refuse or garbage. Rats and bears may also become infested in the same manner.

Trichinella spiralis is a Nematode or round worm. Its larval stage becomes encysted in the muscles of the host. When the human being ingests infected pork which is uncooked or inadequately cooked, the gastric juice frees the encysted larvae, permitting them to pass into the intestine. Here they, in about forty-eight hours, reach adult size. The male is about 1/17 inch in length and the female about 1/7 inch, or more than twice as long. After copulation, the male dies. The pregnant female burrows into the mucosa of the bowel and bears from 1,000 to 15,000 larvae, some of which escape into the bowel while the majority enter the lymphatics and blood vessels. These larvae invade the muscles of the body, seeming to prefer the diaphragm, the tongue and the intercostal and eye muscles. The female, after some weeks, dies and is excreted.

*Presented at the twenty-seventh annual meeting of the Ontario Health Officers Association, held in Toronto, May 22-23, 1941.

The larvae in the muscles become encysted and eventually die, after the cysts become calcified.

The invaded muscles show inflammatory changes, particularly in the region surrounding the cysts. The myocardium rarely shows the presence of encysted larvae, but it occasionally shows a considerable degree of inflammatory change. The meninges are, at times, involved; the brain itself may show the presence of larvae and some granulomatous or chronic inflammatory change.

The symptoms are related to the pathology. The sudden flooding of the muscles with larvae causes muscle stiffness and diffuse muscle pain. If the eye muscles are involved, there is puffiness of the eyes. The associated toxaemia and the presence of the parasites in the bowel produce cramps, nausea and even vomiting. The pulse is rapid, fever is present, and headache occurs. When these symptoms, accompanied by some leucocytosis and a definite eosinophilia, appear in the neighbourhood of two weeks after the ingestion of pork, a diagnosis of trichinosis is indicated.

Most of the information concerning the incidence of the disease in man has been acquired during the last two decades. It has been largely furnished by surveys of autopsy material whereby the diaphragm and other muscles are subjected to microscopic examination with or without previous digestion and concentration. While workers report varying results, many of the surveys approximate 15 per cent of positive findings. It is therefore probable that in Canada and the United States, one individual out of seven has been infected by *Trichinella spiralis*. The incidence appears to be higher in temperate climates than in the tropics. Many cases of "growing pains" or of "slight rheumatic attacks" are in all probability really cases of trichinosis.

The laboratory diagnostic procedures are helpful, but negative results are not necessarily conclusive. An eosinophilia of from 10 to 90 per cent is the most constant positive finding, occurring in almost every case. Examination of stools for adult worms or larvae, and examination of blood and spinal fluid for larvae, give positive results in only a small percentage of cases. Biopsy of muscle gives better results but may be negative in 50 per cent of cases. Intracutaneous tests with an antigen prepared from larvae and used in a 1-10,000 dilution, and precipitin reactions on blood serum, using this antigen in a 1-1,000 dilution, give positive results in perhaps 90 per cent of cases, but these results are not constant until about three weeks after the onset of the disease. The inoculation of rats, guinea pigs, or mice with larvae from blood, spinal fluid, faeces or digested muscle, may establish the diagnosis, but the percentage of positive results is not high. After six months, X-ray pictures of muscles may show the calcified nodules.

TRICHINOSIS IN HAMILTON

In November, 1940, an outbreak occurred in Hamilton, Ontario, involving 23 known cases. The first three patients became acutely ill with nausea, vomiting, muscle pains, fever and puffiness around the eyes, and were admitted to hospital. Blood counts showed moderate leucocytosis and eosinophile counts of 30, 49 and 45 per cent respectively. Allergic disturbance was ruled out.

Worm infestation was considered and samples of faeces requested for laboratory examination. In the meantime, Doctor T. C. Clark, paediatrician, who had recently heard a paper given on a recent outbreak in Rochester, New York, suggested to the authors the possibility of trichinosis, and this indeed proved to be the case. Immediate investigation by Doctor J. E. Davey, Medical Officer of Health, and by Doctor V. Cecilioni, physician attending the cases, revealed the fact that these three cases, together with several others similarly affected but not in hospital, had all eaten sausage purchased from a single dealer on November 2nd or November 3rd, 1940. The picture was then practically complete. Laboratory examination of the faeces of the three hospital patients showed the presence of larvae resembling those of *Trichinella spiralis*. One of these patients, A.Y., became severely ill, showing signs of cerebral involvement, and with some paralysis of leg muscles. Examination of the spinal fluid showed the presence of a few motile larvae, exactly resembling those found in the stools, and one was photographed. All three patients were acutely ill, and biopsy was considered but was not carried out. Samples of blood from all three were carefully examined for larvae, both by microscopic examination and by guinea pig inoculation, with negative results. Table I gives the salient features of these three cases.

TABLE I

TRICHINOSIS IN HAMILTON, NOVEMBER 1940—CASE REPORTS (HOSPITAL CASES)

CASE	1. A.A.	2. A.P.	3. A.Y.
Sex—Age.....	Female—38	Male—14	Female—28
Exposure.....	Nov. 3, 1940	Nov. 3, 1940	Nov. 2, 1940
Onset.....	Nov. 15, 1940	Nov. 19, 1940	Nov. 12, 1940
	Muscle pains and stiffness—14 days Cramps and diarrhoea—4 days Nausea and vomiting—4 days Headache—4 days Puffy eyes—4 days Neck rigidity	Muscle pains and stiffness—7 days Nausea and vomiting—4 days Headache—4 days Puffy eyes—3 days	Muscle pains and stiffness—10 days Cramps—5 days Nausea—4 days Headache—4 days Puffy eyes—4 days Neck rigidity Leg weakness—3 days Delirium—1 day
Temperature ..	101-103°—5 days	101-103°—6 days	100-103°—6 days
Pulse.....	Around 100	Around 95	Around 96
W.B.C.....	18,400	11,100	12,600
Eosinophiles...	Nov. 26—30% Dec. 10—12% May 14— 2%	Nov. 26—49% Dec. 5—21%	Nov. 29—45% Dec. 17—19% Apr. 29—2%
Spinal fluid....	Negative	Negative	Larvae found
Faeces.....	Larvae found	Larvae found	Larvae found
Skin test.....	Erythema—25 mms. Wheal — 9 mms.	Erythema—not done Wheal—not done	Erythema—90x45mms. Wheal —12 mms.
Type.....	Severe	Moderate	Severe

Twenty-three cases, in all, were diagnosed, the source in all cases being sausage from the same dealer. Several of the patients showed little evidence of the disease, beyond some degree of muscle stiffness and a subsequent eosinophilia. The essential features of the twenty cases, not in hospital, are shown in table II.

TABLE II

TRICHINOSIS IN HAMILTON, NOVEMBER 1940—CASE REPORTS (CONDENSED)

Case	Sex	Age	Exposure	Onset	Eosinophiles		—Skin test— Erythema	Wheal	Type
4.....	F	48	Nov. 2	Nov. 25	Nov. 27 May 14	52% 8%	42 mms.	10 mms.	Moderate
5.....	M				Dec. 3 Dec. 10	10% 8%			
6.....	M	22		Nov. 22	Nov. 27 Dec. 17 May 14	38% 23% 2%			Moderate
7.....	M	10	Nov. 2		Dec. 8 May 14	10% 0%	10 mms.	6 mms.	
8.....	F	13	Nov. 2		Dec. 10	13%	20 mms.	6 mms.	
9.....	M	14	Nov. 2	Nov. 26	Nov. 29	48%			Moderate
10.....	F				Dec. 2	19%			
11.....	F	36	Nov. 5	Nov. 21	Nov. 27 May 14	47% 27%	35 mms.	9 mms.	Moderate
12.....	M	10	Nov. 3	Nov. 20	Nov. 29 May 8	46% 10%			Moderate
13.....	F	12			Nov. 29 May 8	27% 4%			
14.....	F	13			Nov. 27 May 4	29% 7%			Moderate
15.....	F		Nov. 2	Nov. 21	Dec. 3 Dec. 7	32% 17%			Moderate
16.....	F	12	Nov. 2	Nov. 15	Nov. 29 May 1	54% 7%			
17.....	F	15	Nov. 3	Nov. 30	Dec. 3	15%			Mild
18.....	M				Dec. 5	41%			
19.....	F	24	Nov. 2 and 3	Nov. 22	Nov. 29	37%			Moderate
20.....	F				Dec. 10	31%			
21.....	F				Dec. 10	45%			
22.....						18%			
23.....						18%			

Doctor A. L. MacNabb, Director of Laboratories, Department of Health

of Ontario, kindly secured for us some Trichinella antigen and skin tests were done on seven of the patients. They were definitely and even markedly positive in all seven. Time and opportunity have not been afforded to carry this out on the remainder, nor to do any precipitin tests on serum.

The primary source of the outbreak was sought by Doctor Davey and his staff, in collaboration with Doctor H. A. Ansley of the Department of Health of Ontario. The pork was traced through a packing company to two primary producers, one of whom had had one case of trichinosis in his own family.

SUMMARY

The occurrence, in November 1940, of an outbreak of trichinosis in Hamilton, involving twenty-three cases, draws attention to the question of trichinosis in general. This disease is probably much more common than has been suspected. The mortality may rise to 15 per cent, although there have been no fatalities in our series. Surveys suggest that, on this continent, perhaps 15 per cent of individuals have been infected. The ingestion of uncooked or partially cooked pork is responsible for virtually all human cases. Grain-fed hogs are rarely infested, but garbage-fed hogs may be, if the garbage contains infested pork clippings, or if the hogs have access to the bodies of infested rats.

The principal control measures are:

(a) Care in the feeding of hogs, especially with regard to uncooked pork clippings and rats.
(b) Rigid inspection of pork before sale (inefficient).
(c) Thorough cooking of all pork or pork products before eating (most efficient of all).

The diagnosis rests on:

(a) A history of consumption of pork.
(b) Symptoms of food poisoning with muscle pains and perhaps puffiness of eyes.
(c) Eosinophilia (present in 99 per cent of cases).
(d) Laboratory examination of stools, blood or spinal fluid for the parasite.
(e) Biopsy of muscle.
(f) Trichinella antigen skin test and precipitin test (after three weeks).
(g) X-ray of muscles for calcified nodules (after six months).

Any treatment is relatively inefficient, and in any case too late to prevent trichinosis, once infestation has taken place.

We should like to express our thanks, for assistance, to Doctor Davey and the staff of the Hamilton Health Department, to Mr. F. J. Elliott and Mr. D. Lock of the Staff of the City Laboratories, Hamilton, to Doctor H. A. Ansley and his associates, and to Doctor V. Cecilioni of Hamilton for valuable assistance with regard to clinical data and the facilitation of laboratory work.

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The Fatigue Syndrome in School Children*

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IT has been my privilege as paediatrician to the Village of Forest Hill Schools to study a series of forty pupils who fall into the diagnosis of chronic fatigue. These pupils were practically all referred to the medical service by their teachers because they were under par in their academic work. This group has proved so interesting and instructive that it was felt worth while to pass on our observations and thoughts with a view to stimulating interest in and understanding of the tired pupil.

At the beginning of the study an attempt was made to define chronic fatigue in school children and to enumerate a set of signs and symptoms as a basis for the diagnosis. It was soon found that there was so much variation in the fatigue pattern that this was an impossible procedure. Each case had to be judged on its own merits. However, the clinical working definition postulated by Seham (1) has been most useful. He states: "Chronic fatigue is a psycho-physiological syndrome of more than three months' duration, the state of sub-efficiency manifesting itself in four ways: 1, feelings of fatigue; 2, actual decrease in the individual's average mental achievement; 3, actual decrease in the individual's average physical strength and endurance; and 4, emotional unbalance."

While it is realized that physical and mental fatigue are inseparable, it is the purpose of this paper to discuss factors which act more directly through the mental component of the syndrome.

HISTORY

In arriving at a diagnosis of fatigue both history and physical examination of the pupil must be considered. History is probably the more important. It may be obtained from three main sources. I would suggest that information obtained from the teacher is the most reliable. Her opinion should be unbiased and she also has a wealth of experience upon which to base her conclusions. Secondly the parent may offer many useful observations. These are particularly valuable if they come spontaneously, rather than in response to direct questioning. Great care must be taken not to put the parent on the defensive when history taking. Lastly, the pupil himself may make observations which lead to establishing the diagnosis. Here, too, spontaneously given information is most valuable.

The complaints in the series are many and varied. Those of emotional unbalance are most numerous. It is learned that the pupil cries frequently

*An address delivered to the Ontario Educational Association, School Health Section, April 15, 1941.

at home or school, for slight cause. Irritability is a very frequent complaint. This manifests itself in such manners as impatience, quarrelsomeness, inability to co-operate in group enterprises. Restlessness is common. This is revealed mentally in a short attention span and physically in inability to remain quiet for a normal length of time. In marked cases temper tantrums may be severe. Initiative may be low and in many cases school work is always behind. Verbal and physical responses are slower than normal. Listlessness is frequent and a defence mechanism of indifference to environment may be built up. The pupil will state that he cannot do certain activities, they are too hard for him. He may simply say he does not like to do certain projects, this being because of a feeling of inadequacy. Headaches may be complained of, sleep becomes restless and insomnia occurs. Many times parents say that it takes the child much too long to get to sleep.

So it will be seen that, from the point of view of the history, the complaints are many. Several may apply to one individual. Usually they occur in the morning and tend to wear off as the day wears on and nervous tension builds up. In only one of our series was there a history that the child was more tired at the end of the day.

EXAMINATION

For the most part examination reveals no organic defect. Six of our forty cases were mildly anaemic. Kerley (2) reports ten of thirty-two cases in his series had slight thyroid deficiencies. Thornton (3) states many of these children are ten per cent. or more underweight. This was not outstanding in our cases. Nineteen were normal or overweight and twenty-one were underweight. Of the latter only four were ten per cent. or more under the average for height and age when compared with the average for Toronto school children. Thus, we would conclude that the lack of appetite mentioned by others was not present in our series to the point of producing appreciable malnutrition. Chronically diseased tonsils and adenoids were found in one case and two others had marked strabismus. Four pupils had fallen metatarsal arches. Two had defective nasal breathing.

Other evidences of fatigue were present in practically all cases. Found most frequently was fatigue or droop posture. The pupil slouched, leaned on the nearest object that would support him and did not seem to have the energy or desire to hold himself erect. Muscle tone was poor. Round shoulders were common. In many instances there were dark circles under the eyes, even to the extent of a sunken appearance. Responses to questions and co-operation during examination were often slow.

GRADE

The grade distribution of cases was particularly significant (table 1).

It will be noted that there are few cases in the grades covering the adolescent period. This is attributed to an especial interest in the adolescent in our schools and the teachers concerned are acutely aware of changes occurring

TABLE I

DISTRIBUTION OF CASES OF FATIGUE

Kindergarten	8	Grade 8	4
Grade 1	1	" 9	1
" 2	5	" 10	2
" 3	12	" 11	0
" 4	2	" 12	0
" 5	1	" 13	0
" 6	2		40
" 7	2		

in pupils at this time, so that fatigue in this group rarely gets beyond the early stage. The fact that twenty-six (65 per cent.) of our cases occurred from the kindergarten to grade three inclusive would emphasize Seham's plea for a more adequate pre-school training in the home. We feel that this is an extremely important factor.

I. Q.

Wharton (4) who has been studying fatigue from the angle of endocrine deficiency suggests that fatigue is found in school children who have a capacity beyond their grade and are held back to fit into the routine of school life: he thinks it is found more frequently in children with a high intelligence quotient (5). This was obtained in twenty-seven of our cases. Wharton's impression is substantiated in this series, all but two being within normal range or above.

I. Q.	No. of Cases
74	1
80	1
95 to 100	6
101 to 105	3
106 to 110	1
111 to 115	1
116 to 120	6
121 to 125	6
126 to 130	2
	27

A study of this group of children reveals the fact that the majority have not been filling as complete a program as experience has shown they should for their chronological age and inteligence rating. Therefore it is felt that in these pupils over-organization of their time is not a factor; that there must be some other cause for the appearance of chronic fatigue. Several factors are found to be operative, some of which may be briefly listed as follows:

1. Physical defects.
2. Home factors.
   (a) Lack of discipline, guidance and adequate rest periods.
   (b) Maladjustments between parents, including broken homes.
   (c) Maladjustments between child and parent.
3. Adolescent changes.
4. Lack of pre-school preparation.

Our study of this interesting group is progressing.

Also of interest is the sex distribution. Boys predominated; there were thirty boys and ten girls.

FACTORS INVOLVED IN THE PRODUCTION OF FATIGUE

The factors involved in the production of fatigue in school children are legion. They may be classified into three main groups: those of the child himself, those of the school environment, and those of the home environment. These three are inseparably linked. A brief discussion of some of the components of each may be of value.

The Child: For the most part physical defects that cause fatigue are remediable, *e. g.*, anaemia, diseased tonsils and adenoids, defective vision, many cases of defective hearing, the allergies, postural defects, and many others. Foci of infection should be removed or treated. It is impossible to achieve correction of chronic fatigue as long as physical defects persist.

The psychological make-up of the child may play a large part. Maladjustments must be taken care of. This may take a great deal of time and care on the part of the teacher and other members of the school staff. The emotional stability of the child is on a lower level than that of the adult and emotional stimulation should be at the child's level.

The School: The most important influence at school is the teacher. She must at all times be a student of child psychology. She must know her pupils individually so that she can be ever on the alert for signs of slowing up in accomplishment, changes in disposition and posture or other evidences of oncoming fatigue. Then she must be interested enough to investigate and ascertain the reason for such a condition. She may send the child to the physician to rule out disease processes. She may consult the parents as to habits, diet or other home influences. She should be ready to give advice to both the pupil and parents. Also, it is her duty to see that the individual is working at his mental level. If he is above it, pick-up classes or more personal attention or a shift to a class at his own level may be advisable, because boredom ultimately results in fatigue and lack of general interest. If he is below his mental level, opportunity classes or extra school activities may be advised.

Added to all this the teacher should be cheerful, even-tempered, a good disciplinarian and loved rather than feared by her pupils. An environment of fear, continual nagging and excessive discipline of the sterner type induces fatigue with great readiness unless the child is well above the average in emotional stability.

Other factors in the school are improper ventilation and lighting. Continual insults in these areas will cause chronic fatigue. In many of our classrooms these are watched by the pupils and have educative value.

Another cause may be too full school programs in the form of after-hour projects. A few might be mentioned as too strenuous sports programs, too many "demonstrations" requiring much practice and drill outside the classroom, coupled with late hours.

The Home: It is felt that the home bears the major portion of the guilt in the production of chronic fatigue in the school child. In many cases the home habits are faulty. Parents have a great responsibility in regard to the

building up of physical and mental health habits in the child. The establishment of adequate physical and mental health habits must be begun in infancy and carried throughout childhood. Too commonly this responsibility is shirked and handed over to a third person or to the school staff. Seham suggests that the child is so highly susceptible to fatigue when of school age because there is lack of preparation for school work. This preparation rightly belongs to the parents. It is their duty to build up a set of habits with a certain amount of discipline so that the shift from the natural habitat of freedom, fresh air, sunshine and play to the artificial regime and fixed responsibilities of school will not be too great.

Apart from this, many parents lay the foundation for or build up fatigue in other ways. Maladjustments between parents in the home induce fatigue and cause uncertainty in the child. Also an excessively stern, demanding parent who expects implicit obedience, giving in return, no sympathy, understanding or interest in the affairs of the child, fosters this condition. Parental irritability and nagging abet it. Lack of discipline may have the same effect. The child should feel that the parents are more than taskmasters. There should be confidence and a sense of comradeship which is built up through understanding, interest and a sense of responsibility on the part of the mother and the father.

Sleep is another important factor under control of the home. Definite hours for retirement may be set out for guidance but it must be remembered that certain individuals require more sleep than others. It is the wise parent who realizes this and governs the hours of rest accordingly. The pre-bedtime program is important. It should be non-stimulating and the curse of the modern radio program with its bedtime thrillers should be fought by all educators. Commercial firms should not be allowed to advertise at the expense of the health of the child. Many children have radios in their rooms or have to attempt to sleep against the blare of a radio in some other part of the house. In such circumstances sleep can only be light and restless and what should be the best hours of the night are lost. Moving pictures, also, unless carefully selected, are an adverse influence on proper sleep. Excess mental stimulation received by a child through watching highly emotional, fast-moving adult pictures can only retard the onset and impair the depth of sleep. It is also interesting to note that in several of the classrooms where we have kept sleep records, the pupils going to bed well after the optimum hour have been, almost without exception, the poor pupils in the classrooms.

It has been already noted that chronic fatigue apparently appears in children of normal or high intelligence rather than in those with a low quotient. It would seem that the explanation for this is that with such children the day may tend to become too highly organized, too full. There are insufficient rest periods to allow for recovery from mental and physical exercise, the end result being manifestations of fatigue. This condition results from the increased pressure of modern living which has been extended downward to the childhood level. Such things as music lessons, dancing lessons, organized sports, children's clubs, scouts, dramatics, art classes and a multitude of

others so fill the child's day that there is no period for relaxation. Added to all these may be necessary hours of homework. Such activity programs tend to be overdone in the more intelligent child, largely because there is an incessant urge on the part of educator and parent alike to push him ahead as far and as fast as he will go, until he rebels with chronic fatigue. On the other hand, as would be suggested from our series, chronic fatigue may be present in pupils who are not living up to their mental capacity. This results in boredom. It is felt that such boredom may be a very important factor in the production of chronic fatigue. A child should live up to his mental level at school and at home and at the same time great care must be taken to assure adequate rest periods.

Poor diet, or rather poor food habits, may also be a factor. Many children have pronounced likes and dislikes and eat unbalanced or deficient diets. Breakfast is frequently a poor meal, insufficient carbohydrate being taken to last through the morning. Candy and food between meals lessen appetite so that meals are improperly eaten. The vitamins, particularly vitamin B_1, are factors in the prevention of nervous or mental fatigue. Much of this valuable food accessory is lost through faulty food habits and preparation. A study of the dietary habits of the fatigued child may give information of real value in its correction.

Granted that chronic fatigue is a problem in school children which is apparently on the increase, wherein lies the solution for its cure and prevention? It would seem that the answer is education. This should take place first of all with the group most concerned, the school children. The inculcation of proper health habits by all educational methods at our command should be attempted. The child should be taught to take pride in his health and constant repetition of health rules is necessary. The next line of attack is the parent, whose co-operation is so essential. Parent-education groups, home and school clubs, church groups, and women's clubs are fertile places for parent education. It is our duty as educators and health workers to see that these groups receive proper guidance in this field. Parents must be made to realize that childhood emotional stamina and stability are far below the adult level. When this factor is grasped, they will readily see the need for increased rest, more play, fewer radio and movie programs and a satisfactory emotional balance in the home.

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DESIRABLE QUALIFICATIONS FOR PUBLIC HEALTH NURSING

IT is a truism in all professional life that effective practice in a given field is dependent largely upon well qualified personnel. Hence the significance to public health administrators and to public health nurses of two documents recently published. Both are in the form of reports and deal with the qualifications of public health personnel. The one issued by the United States Public Health Service, in the bulletin "Public Health Reports", gives the findings of a survey made recently of the factors contributing to a well prepared public health nurse, such as general educational background, professional training, and experience in nursing and in public health nursing. Certain conclusions will interest Canadian readers: first, that nurses represent not only the largest professional group of public health workers, but compose almost one-half of the full-time personnel of departments of health; second, that although some improvement is noted in the general educational level of nurses entering professional schools during the past ten years, there is still wide variation in basic educational attainment with continued lack of standardization in basic requirements for entrance to these schools; and, third, that in spite of the increase in the number of public health nurses who have had special preparation, only half of those employed by departments of health have had special training and but one in six has had as much as a year of special preparation.

The second report consists of recommendations concerning minimum requirements for employment in public health nursing prepared by a committee of the Public Health Nursing Section of the Canadian Public Health Association and printed in the August number of the Journal. The report advocates a minimum entrance requirement of pass matriculation, but, as in the United States of America, this is a standard not yet achieved as an entrance requirement to all schools of nursing. Recommendations regarding professional qualifications include a diploma in nursing and in public health nursing from a recognized hospital or from a university school or department. Attention is drawn to the possibility of securing such professional preparation through a well-integrated training requiring from three to four years, in

which health nursing is emphasized throughout, and at the end of which a diploma is granted in public health nursing as well as in hospital nursing. The report, quite rightly, notes the limitation of present facilities through which this preparation can be obtained, although one or two university schools have made a beginning. Advisedly, personal qualifications are included, the first of which merits emphasis: good physical health, a favourable personality, emotional stability and sound character.

In fairness to the Canadian situation, it must be stated that, in the main, agencies employing public health nurses have accepted these qualifications as necessary in the appointment of staff workers. If, however, public health nurses are to fulfil their function with acceptance to the employer and the community at large, and are to meet an increasing demand for their services, some method must be found of attracting to hospital and university schools in larger numbers young women of intelligence, interest and of solid home training in which a sense of life's spiritual values and purposes has been recognized, and, further, an educational background of at least pass matriculation. With this foundation there will then be secured a basic professional training in a recognized hospital school followed by an academic year of special preparation afforded by a university school or department, *or* a training in both nursing and public health nursing at one and the same time through a university school in which public health nursing is included in the basic training rather than added at its close.

Obviously there cannot be a sufficient number of public health nurses with such qualifications in this country until public health administrators and other employers make a concerted effort, through planning in advance, to secure the right material and then to expose that material to the type of training which will result in the quality of product they wish to employ. In this way, and this way alone, will the growing demands for well prepared public health nursing personnel be adequately met throughout Canada.

Florence H. M. Emory

INDUSTRIAL HYGIENE ABSTRACTS

Overtime and Overtiring

In this editorial stress is laid on the importance of conserving energy. Working to capacity does not mean working each man, woman and young person for as many hours as he or she can stand at a machine. Today some employers do not yet realize this. Hence, overtiring from long hours has led in many factories to the same situation as was found in industry in 1916, a state of reduced efficiency and lowered health. That overtime is extravagant on mere economic grounds was also proved by experience during the first World War.

The hours worked by women and by young people under 18 are controlled by law. Shortly after the outbreak of the present war the standard for young people 14-16 years of age, namely, not more than 48 hours a week at the outside, was laid down by the Ministry of Labour. A recent court case mentioned in this editorial shows how this standard now is being overridden, and findings of the subcommittee on supply services show cases where women are being overworked.

The heaviest burden of overtime, however, is falling upon grown men and here the Government has no legal control over the hours of work. Within two months after Dunkirk the long hours necessitated in many factories had led to increased sickness and absenteeism. In July of last year a circular issued by the Ministry of Labour recommended an immediate reduction to an average of 55 or 56 hours a week as soon as the necessary labour force had been acquired. Despite this, there is still evidence of suffering under strain.

The question of overtime is a complex one, being bound up with the interests of the fighting services, the trade-unions, the employers and the workers. Fortunately wise employers are realizing the direct relation between long hours and absenteeism. Some managers have deliberately reduced hours to increase output.

The subcommittee on supply services recommend an immediate reduction of hours to the level recommended by the Ministry. In addition they advocate the three-shift system as a means of safeguarding the health of the workers and at the same time of ensuring maximal output.

Editorial in The Lancet, February 8, 1941, p. 181.

Industrial Hygiene Problems in the National Defence Program

In the United States, by authority of the Council of National Defence, the Federal Security Administrator appointed the Subcommittee on Industrial Health and Medicine to act as his advisor in industrial health and medical activities relating to the national defence. In this article the author gives a summary of progress since the creation of this Subcommittee.

By virtue of experience and research the Division of Industrial Hygiene of the National Institute of Health was considered to be in a position to carry out many of the recommendations of this Subcommittee and is therefore the logical agency for leadership in achieving the defence objectives at the present time.

In addition to the needs to which the Division of Industrial Hygiene is already committed, which include (1) the investigation and control of specific industrial hazards, (2) advice to industry and others on the location of new plants and the renovation of old ones, (3) the promotion by industry of physical examinations and medical services, (4) the preparation and dissemination of information on various toxic materials and processes, and (5) the promotion of measures for the control of syphilis, tuberculosis and other communicable diseases among indus-

trial workers, the Subcommittee on Industrial Health and Medicine recognizes other pressing needs. They are as follows:

1. Expansions in personnel, facilities and funds of state and federal industrial hygiene units.
2. Surveys of arsenals and navy yards and training of necessary personnel.
3. Surveys of commercial shipyards, airplane plants, and manufacturers of military vehicles and munitions, and training of necessary personnel.
4. Promotion of first aid in (a) construction of isolated plants, and (b) in connection with disasters.
5. Toxicological researches on materials vital to national defence, as toluol, TNT, etc.

Realizing the importance of the medical profession in connection with such activities, in January 1941 representatives of this Subcommittee formed a Joint Committee with members of the Council on Industrial Health, American Medical Association. In their report they urge the fullest cooperation between all the medical agencies, official and non-official, as well as the technical and engineering skills concerned. They stress the need for coordinating the industrial health programs and the medical profession.

In their recommendations they discuss the immediate need of additional funds and personnel for both Federal and state agencies, funds for the training of new personnel, and funds for urgently required research. They discuss in detail the cost of such a program and the method of its accomplishment. This includes the organization of training courses for physicians and engineers and the conducting of industrial hygiene training courses in governmental plants, research into harmful properties of many substances which have lately come into use in munitions manufacture, and the provision for the welfare of workers and their families in the new rapidly developing communities.

Such recommendations adopted and put into practice, would mean a big step in forwarding the present industrial hygiene program in the country.

The Subcommittee on Industrial Health and Medicine is exploring other fields also, which are related to the health of industrial workers, such as psychiatry and nutrition.

C. D. Selby, Indust. Med., 1941, *10*: 118.

Effect of Short Rest Pauses in Standing and Sitting Position on the Efficiency of Muscular Work

INVESTIGATION by the Industrial Fatigue Research Board in Great Britain and by research workers in other countries has demonstrated the favourable effect of short rest pauses introduced in industrial work. It has been recommended that where work is performed in the standing position, the rest should be taken in the sitting position owing to the fact that the oxidation recovery speed is higher in that position.

In a study of the effect of regular short interruptions (alternating intervals of two minutes work and one minute pause) on the oxygen consumption during lifting loads with both arms it was shown that not only was endurance increased but the oxygen consumption during the rest periods remained as high as during the work periods. The height of this steady state of oxygen consumption was considerably less than during the same type of work without interruptions.

It is important to determine how best to use such short pauses. In this article the authors describe in detail experiments conducted to compare the efficiency of lifting loads interrupted by short rest pauses, when the subject (a) was standing, (b) was seated during the rest pauses.

The experiments were conducted using two female subjects, 20 and 22 years of age. Two different loads were used and the experiment was done at three different speeds. The exercise consisted of alternating inter-

vals of one minute work and one minute rest. The following results were obtained:

1. The efficiency of muscular work (lifting loads) was increased when the work was interrupted by regular and short pauses of one minute duration.

2. The increase was more pronounced when the subjects were allowed to sit during the intervals.

The authors feel that these results in the light of the evidence they bring to bear on the question of fatigue and oxygen consumption, may be regarded as a physiological basis upon which to explain the known favourable effect of short interruptions. They also suggest the advisability of introducing pauses in the sitting position.

Ernst Simonson and Norbert Enzer, J. Indust. Hyg. & Toxicol., 1941, *23*: 106.

BOOKS AND REPORTS

Plague on Us. *By Geddes Smith. New York: The Commonwealth Fund, 1941. 365 pages. $3.00.*

THIS book is written by a layman but one would hardly recognize the fact, for he knows his subject better than most professionals and although it is evidently written for the multitude few experts will read it without profit. In many ways he sees the picture more clearly than most professional epidemiologists. He has no axe to grind and does not push any particular theory, a fault which besets so many of those whom he kindly describes as "left-wing epidemiologists".

The general plan of the book follows conventional lines, the chapter headings comprising Pestilence, Past Thinking, The Sick Man, The Sick Crowd, Defenses, Detective Work, and Unfinished Business. There are not only adequate descriptions of the great epidemics of the past, together with some intensely interesting ones of recent years, including the epidemic of amoebic dysentery in Chicago, but the experimental epidemiology of Topley, Greenwood and Webster also gets its due meed of attention.

While an understanding of bacteriology and immunity is essential in discussing the natural history of epidemics, the treatment of these cognate subjects is perhaps rather fuller than is desirable. Certainly one cannot quarrel with his material, for it is all accurately reported, but there is too much of it and much of it is irrelevant. The work of Stanley on the crystallization of viruses, or recent discoveries on the structure of the protein molecule (illustrated by a very beautiful figure), to quote two instances, may be of importance in understanding disease in the future, but they are of little value at the present moment. There is no doubt whatever that the author enjoys these fascinating bypaths, but the layman may well be in great danger of hopelessly losing himself.

Perhaps the best part of the book is the style in which it is written. It is racy without being vulgar, to the point but not dry or pedantic. There is ample evidence of very wide reading on the subject, for his quotations range from Creighton and Chapin to Gilbert and Sullivan and the pages of nineteenth century newspapers published in obscure localities of the United States. But too many of his best and most apposite statements are relegated to footnotes.

Another very pleasing feature is the absence of detailed references, but the inclusion at the end of each chapter of a list of sources from which the material was obtained. This will no doubt confound those who love to see their small contributions referred to but is of immeasurably greater value to the student.

This book is a worthy fellow to those which have preceded it from the

Commonwealth Fund and can be confidently recommended to all who have any interest in the epidemics which, even in these times, may assail us.

Ronald Hare

Psychiatric Social Work. *By Lois Meredith French. New York: The Commonwealth Fund, 1940. 344 pages. $2.25.*

IN this book we have a comprehensive study of psychiatric social work in the United States of America. The contents are confined to a discussion of the growth and development of psychiatric social work across the border but members of public health organizations, physicians, nurses and social workers in this country will find much valuable information within its pages.

Mrs. French corrects the widespread belief that psychiatric social work was created by the first great war and states that social work in state hospitals was well established in New York and Massachusetts by 1918.

The portion dealing with psychiatric social work in public schools (pages 176-183) should be of particular interest to those engaged in this work. The young worker is reminded that the responsibility of the welfare of a child rests with the principal and teacher, therefore suggestions made by the social worker must be weighed in relation to group welfare and administrative procedure.

In the reviewer's opinion the chapter (pages 242-293) on professional education, while discussing at length academic and special training requirements, does not attach sufficient importance to the personality of the worker. A sympathetic appreciation of human weakness and failure, in this reader's viewpoint, should be a basic qualification and cannot be too strongly stressed.

The book is a very thorough study of psychiatric social work and is a valuable contribution to public health literature.

Mrs. French points out that "whatever the direction of growth during the next few years, psychiatric social work is strongly entrenched as an essential part of child guidance service."

Isabel J. Dalzell

The Public Health Nurse and Her Patient. *By Ruth Gilbert. New York: The Commonwealth Fund, 1940. 372 pages. $2.25.*

THIS book deals with some of the underlying forces that give meaning to the daily work of the public health nurse and thus make for satisfaction in the day-to-day progression toward the realization of an ideal. Miss Gilbert is well equipped to discuss situations that confront public health nurses and she has done so with deep understanding and consummate skill. The book is divided into six chapters, as follows: Mental Hygiene in Public Health Nursing, Nursing the Sick Patient, Teaching Health, Nurse and Maternity Patient, The Child in His Family, and Relationships with Co-workers.

The Public Health Nurse and Her Patient is well written, fully documented and carefully indexed. The use of familiar situations to illustrate the many points discussed makes the application vivid. It will make a valuable addition to the library of the health agency, including hospital and sanatorium. Nurses in all fields, as well as health officers, sanitary inspectors and social workers, will find it interesting and helpful.

Edna L. Moore

LABORATORY SUPPLEMENT

FOR THE PRESENTATION OF TECHNICAL PAPERS IN BACTERIOLOGY, PATHOLOGY, IMMUNOLOGY, CHEMISTRY, PARASITOLOGY, AND ALLIED FIELDS IN RELATION TO PUBLIC HEALTH

The Adsorption of Influenza Virus by Red Cells and a New in Vitro Method of Measuring Antibodies for Influenza Virus

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IN a recent communication, Hirst (1941) described the agglutination of chick red cells when they are immersed in the allantoic fluid of hen's eggs infected with influenza viruses A or B. The same phenomenon had been independently observed by us and this paper is an account of experiments which show that it is probably related to the adsorption of the virus by the cells. While this adsorption effect may have a number of applications, the agglutination which also occurs provides a very useful test for free virus. Since it is to be expected that virus subjected to the action of specific antibodies may react differently, experiments have been carried out to explore the possibility of devising a simple *in vitro* supplement or substitute for the neutralization test in the mouse.

METHODS

Viruses Employed. Egg adapted PR8 virus, obtained from Dr. F. L. Horsfall, was employed as a representative of influenza A. The Lee strain of influenza B, adapted to eggs by ourselves and now in its twenty-fourth generation, was employed for some of the experiments.

Inoculation of Eggs. Hen's eggs after incubation for ten days were inoculated through a small drill hole in the shell into the peri-embryonic space and then incubated for two days.

Collection of the Allantoic Fluid. The egg is stood upright with broad end uppermost and the shell removed over the air sac. Shell membrane and chorioallantoic membrane are picked up with forceps and carefully torn to make a fairly large opening through which a pipette is inserted into the fluid. This procedure, if carried out carefully, can be done with very little damage to blood vessels and from 2 to 5 cc. of clear allantoic fluid can be evacuated.

Collection of Red Cells. For most of our work we have employed red cells collected by heart puncture from one or two day old chicks anaesthetised with ether. The blood was delivered into a large volume of saline without citrate and then centrifuged. In other experiments in which the blood of larger animals was employed we made use of defibrinated blood. In any event the cells were

thrown down from a large volume of saline and the supernatant fluid removed. The packed cells were then added to saline to give a suspension of 0.25 per cent. Washed cells were not used.

Virus Neutralization Tests in the Mouse. These were carried out by the method of Francis *et al.* (1937) using either mouse adapted PR8 virus and 1000 M.L.D. of the virus in each dilution of the serum or the Lee virus with only 100 M.L.D. The end point was calculated according to the method of Reed and Muench (1938) as that dilution of the serum which would give 50 per cent protection against death.

Titration of Sera by Inhibition of Agglutination. Drops containing 0.05 cc. of normal saline were placed on paraffin slides. Twofold dilutions of the serum to be tested were made by adding 0.05 cc. to the first drop and so on to the end. To each drop was then added 0.05 cc. infected allantoic fluid and 0.025 cc. of 0.25 per cent chick red cells in saline. The mixtures were then transferred to a glass plate ruled in squares, rocked for a few minutes and then examined under a low power microscope. Controls with uninfected fluid were also set up.

RESULTS

When a hen's egg infected by the peri-embryonic inoculation of influenza viruses A or B is opened after forty-eight hours' incubation and an attempt made to withdraw allantoic fluid, haemorrhage into the fluid from vessels which have been injured in the process frequently occurs. The liberated red cells immediately agglutinate and Hirst (1941), who first described the phenomenon, suggested that it might serve as a useful indication that living virus is present in the egg. From our own observations we are in agreement with this. We found the agglutination of the cells of considerable value when adapting influenza B virus to eggs; for in the first passages only occasional eggs became infected. A number of experiments have been carried out in order to throw further light on the agglutination phenomenon.

Species of Cells Susceptible to Agglutination. Red cells obtained from a number of different species were prepared as described above in the form of 0.25 per cent suspensions in saline. Similar suspensions were made with cells washed three times with saline. Mixtures were then made, consisting of 0.05 cc. of fluid from normal eggs or from eggs infected with influenza virus A or B and 0.025 cc. of cell suspension. They were transferred to a glass plate ruled into one-inch squares with a grease pencil, rocked for a few minutes and then examined under the low power microscope. For much assistance in this technique we are deeply indebted to Dr. D. G. Gemeroy. A thin suspension of cells is essential, and thicker suspensions of cells or attempts to read the test by macroscopic examination have not proved very satisfactory. The results are given in table I, from which it will be seen that precisely similar results were obtained with both washed and unwashed cells. The two viruses behaved in similar fashion in that only chick, hen, guinea pig and human cells were agglutinated, those of the other species, with the possible exception of the horse, remaining unaffected.

TABLE I

AGGLUTINATION OF THE RED CELLS OF DIFFERENT SPECIES BY INFECTED ALLANTOIC FLUID

Species of cell	Fluid infected with		Normal allantoic fluid
	A virus	B virus	
Embryo chick	++++	++++	−
Day old chick	++++	++++	−
Hen	++++	++++	−
Guinea pig	++++	++++	−
Human beings	++++	++++	−
Rabbit	−	−	−
Rat	−	−	−
Mouse	−	−	−
Horse	±	−	−
Sheep	−	−	−

Precisely similar results were obtained with washed cells.
−signifies no agglutination, + to ++++ degrees of agglutination.

Effect of Heat on the Fluid. After thirty minutes at 56-57°C., a temperature usually sufficient to kill the virus (Fairbrother, 1938), the fluid loses its ability to agglutinate the cells and the power to do so is not restored by the addition of normal fluid.

Possible Explanations for the Phenomenon

It would seem probable that the cells become coated with the virus and in consequence their electric charge is altered in such a manner as to bring about their spontaneous agglutination. The fact that heating the fluid at 56°C., a temperature which is adequate to destroy this virus, prevents the agglutination, would suggest that living virus is necessary. Further, fluid which has been treated by the addition of one-tenth of its volume of packed red cells and then centrifuged, was found to have lost much of its ability to cause agglutination, for while the unabsorbed fluid would agglutinate up to a dilution of 1/64, that after absorption would agglutinate only up to 1/8. The following experiment also suggests the adsorption of the virus on the cells.

Infected fluid was taken and one-tenth of its volume of packed chick or guinea pig cells added. The fluid and cells were well mixed and then centrifuged for fifteen minutes at 3500 r.p.m. in the more horizontal position of the angle centrifuge. The supernatant fluid was removed and the cells re-suspended in the same volume of 10 per cent serum-saline as in the original suspension. Decimal dilutions of the unabsorbed fluid, the supernatant and the cellular suspension were then made and 0.05 cc. of each dilution instilled into three mice under ether anaesthesia. Deaths were recorded up to the tenth day when the experiment was terminated. It was thus possible to ascertain the minimum lethal dose (M.L.D.) of each suspension. The results are given in table II.

From this experiment, it would appear probable that the red cells had removed a large proportion of the virus from the fluid but had not inactivated it in any way for it was present on the cells themselves, giving them, after re-suspension, as high an M.L.D. as the fluid itself. The fact that rabbit cells

TABLE II

TO SHOW THE ADSORPTION OF PR8 VIRUS BY THE RED CELLS OF CHICK AND GUINEA-PIG CELLS, BUT NOT BY RABBIT CELLS

		Highest dilution causing death of the mice
A	Fluid before treatment	$<10^{-4}$
	Fluid after treatment with 10 per cent chick cells and their removal by centrifuging at 3,500 r.p.m.	10^{-4}
	Cells from above re-suspended in saline	$<10^{-4}$
B	Fluid before treatment	$<10^{-4}$
	Fluid after treatment with 10 per cent guinea-pig cells and their removal by centrifuging at 3,500 r.p.m.	10^{-5}
	Cells from above re-suspended in saline	$<10^{-4}$
C	Fluid before treatment	10^{-3}
	Fluid after treatment with 10 per cent rabbit cells and their removal by centrifuging at 3,500 r.p.m.	10^{-4}
	Cells from above re-suspended in saline	10^{-3}

which do not become agglutinated in infected fluid, failed to adsorb the virus confirms this idea and shows that the virus was not driven down mechanically by the red cells.

In other experiments, cells were added to the fluid, well mixed and the whole then frozen and thawed a number of times. This caused haemolysis of most of the cells. The preparation was then centrifuged at 3500 r.p.m. and the M.L.D. of both supernatant fluid and cell debris determined by dilution and instillation into mice as before. The results are given in table III. It is evident from this

TABLE III

TO SHOW THE PERSISTENCE OF THE ADSORBED VIRUS ON THE RED CELL DEBRIS AFTER THEIR DISRUPTION BY FREEZING AND THAWING

		Highest dilution causing death of the mice
A	Fluid before treatment	$<10^{-4}$
	Fluid after addition of 10 per cent chick cells to fluid, freezing and thawing three times and then centrifuging at 3,500 r.p.m.	10^{-3}
	Cell debris from above re-suspended in saline	$<10^{-4}$
B	Fluid before treatment	$<10^{-4}$
	Fluid after treatment as under A with guinea-pig cells	10^{-3}
	Cell debris as under A	10^{-7}

that the virus is adsorbed on the cell envelope for when the cell debris was re-suspended, the M.L.D. of the suspension was almost as high as that of the fluid in the first place.

Thus these experiments indicate that both avian and mammalian red cells may be able to adsorb influenza viruses A or B from infected allantoic fluid. This causes the red cells of chick, guinea pig, or human being to undergo spontaneous agglutination whereas the cells of other species remain discrete. Many possible applications of this phenomenon might be cited. We have, however, concentrated on its possible use in the virus neutralization test.

THE USE OF RED CELLS AS INDICATORS OF UNNEUTRALIZED VIRUS IN THE SERUM VIRUS NEUTRALIZATION TEST

If red cells become agglutinated in the presence of free virus, it would seem highly probable that in neutralization tests where dilutions of serum are added to constant amounts of virus, there would be agglutination if red cells were added to the higher dilutions where free virus is still present and no agglutination in the lower where it has been neutralized. Sera from cases of influenza were therefore taken and dilutions made with saline. Equal amounts of infected allantoic fluid were then added and the mixtures allowed to stand for a few minutes. Red cells suspended in saline from day-old chicks were then added and the mixtures observed on a glass plate under the microscope.

In the higher serum dilutions, almost instant agglutination occurred. Then came a zone in which there was only partial agglutination, to be followed in the lower dilutions by no agglutination at all. The results obtained with sera taken during the acute and convalescent phases of influenza A, other influenzal infections not due to influenza A, from an individual who had been immunized with influenza A vaccine and from normal and convalescent ferrets are given in table IV.

TABLE IV

TITRATION OF ANTIBODY BY INHIBITION OF AGGLUTINATION

Serum	Time of bleeding	Final dilution of serum in the mixtures								Normal fluid
		1/4	1/8	1/16	1/32	1/64	1/128	1/256	1/512	1/4
Cases of influenza A										
FIS	Acute phase	++	+++	++++	++++	++++	++++	++++	+++++	–
	Convalescent	–	–	–	–	–	–	++	+++	–
MCH	Acute phase	–	+	++	+++	++++	++++	++++	++++	–
	Convalescent	–	–	–	–	–	+	++	+++	–
BSR	Acute phase	–	++	++	++++	++++	++++	++++	++++	–
	Convalescent	–	–	–	–	++	+++	++++	++++	–
Influenza but not due to influenza viruses A or B										
HUS	Acute phase	–	–	+++	++++	++++	++++	++++	++++	–
	Convalescent	–	–	+	++	++++	++++	++++	++++	–
Inoculation with influenza A vaccine										
COR	Before	–	+++	+++	+++	++++	++++	++++	++++	–
	14 days after	–	–	–	++	+++	++++	++++	++++	–
Ferret sera										
Normal serum		+	++	++++	++++	++++	+++++	++++	++++	–
Convalescent after PR8 infection		–	–	–	–	–	–	–	++	–

Mixtures consisted of 0.05 cc. serum dilutions
0.05 cc. PR8 infected fluid
0.025 cc. 0.25 per cent chick cells.
–signifies no agglutination, ++++ complete agglutination.

It is a little difficult to judge the exact end point and much patience and practice are required before this becomes easy. We have taken the highest dilution in which no agglutination at all occurs as the end point and then corrected for the dilution of the serum by the added allantoic fluid. No cognizance of the fluid in which the cells were suspended was taken. The titres in table IV would therefore be > 1/4, 1/128, 1/4, 1/64, 1/4, 1/32, 1/8, 1/8, 1/4, 1/16,

> 1/4 and 1/256 from above downwards. We have not encountered a human serum which possessed agglutinins for chick cells but many human sera will agglutinate guinea pig cells, some in as high a dilution as 1/64. Although such cells give much better agglutination and a much easier end point to read, they are for this reason valueless for general employment.

The Effect of Variations in the Time of Contact between Fluid and Serum before the Addition of the Cells on the Final Titre Obtained. In the above tests the red cells were added very soon after the fluid and the sera had been mixed. In neutralization tests it is usual to incubate the mixtures for some time before instilling them into the animals. We have, therefore, carried out experiments in which sera were diluted, infected fluid added and the mixtures incubated at 37°C. for ten, twenty, and thirty minutes before the addition of the cells. The titres obtained in this way were compared with the titres obtained with mixtures to which the red cells were added immediately. No differences could be detected between any of the titrations. It is, therefore, probable that the union of antibody and virus occurs almost immediately.

TABLE V

TO SHOW THE EFFECT OF DILUTION OF THE FLUID ON THE END POINTS OBTAINED IN NEUTRALIZATION TESTS

Serum	Final dilution of infected fluid in the system				
	1/2	1/8	1/16	1/32	1/64
Acute	>1/4	1/32	1/64	ND	ND
convalescent	1/16	1/128	1/256	ND	ND
Acute	>1/4	1/4	1/8	ND	ND
convalescent	1/128	1/256	1/1,024	ND	ND
Controls without serum Degree of agglutination of chick cells	++++	++++	++	+	−

Effect of Variations in the Virus Content of Mixtures on the End Point in Neutralization Tests. Fluid was taken and used for virus neutralization tests, undiluted, and after dilution ¼ and ⅛. The results obtained with two sets of sera are given in table V. From this it is obvious that the virus content of the system does make considerable differences to the end points obtained.

Correlation between the Titres Obtained by the Inhibition of Agglutination of Red Cells and the Neutralization Test in Mice. Sets of sera from cases of influenza, from influenzal infections not due to influenza viruses A or B, and also from normal persons who had been immunized with the complex vaccine of Horsfall, Lennette and Rickard (1941) were available. All had been heated at 56°C. for thirty minutes. The titres of all the sera for PR8 in the ordinary mouse neutralization tests had been ascertained and for Lee virus in some of them.

Preliminary tests showed that with undiluted allantoic fluid, infected with

PR8 virus, the titres obtained by the inhibition of agglutination were much lower than in the mouse tests. It, therefore, seemed advisable to use less virus for the tests by diluting the fluid, and so increase the titre as in table V. There was also evidence that the virus content of different fluids might vary considerably, giving different end points with the same serum.

For these reasons an attempt was made to standardize the test as much as possible, and to obtain widely spaced titres with regularity. The following method was adopted. The allantoic fluid was first titrated in the following way: twofold dilutions of the fluid were first made with saline, red cells were added and the point determined at which agglutination ceased. With most fluids there was weak agglutination at 1/64 and none at all at 1/128. The fluid was then diluted with saline so that there would be ± agglutination at 1/32 and none at all at 1/64. With most fluids, this entailed dilution of ½ with saline before use. This strength of virus gives, in our hands, higher titres which are more comparable to those obtained in the mouse tests than undiluted fluid. The sera were, therefore, all tested with fluid of this strength using hen red cells.

A control serum was included in any series of tests and usually the same titre was obtained with different fluids prepared as above.

The sera were tested with both PR8 and Lee infected fluids. As no proper control serum for Lee virus was available all the tests with this virus were carried out with one pooled sample. The results are given in tables VI, VII, and VIII.

TABLE VI

CORRELATION BETWEEN TITRES OBTAINED BY THE INHIBITION OF AGGLUTINATION AND IN THE MOUSE

Cases infected with influenza A virus

Patient	Time of bleeding	A virus		B virus		Agglutination in serum + normal fluid
		Inhibition of Agglutination	Tests in mice	Inhibition of Agglutination	Tests in mice	
GOB	Acute	>1/4	1/15	1/16	>1/4	–
	Convalescent	1/256	<1/270	1/16	>1/4	–
SCO	Acute	1/4	1/8	>1/4	>1/4	–
	Convalescent	1/512	<1/270	>1/4	>1/4	–
McH	Acute	1/8	1/2	1/8	>1/4	–
	Convalescent	1/256	<1/270	1/4	>1/4	–
FIS	Acute	1/8	1/2	1/4	1/45	–
	Convalescent	1/256	<1/270	1/4	1/45	–
WIL	Acute	1/16	1/8	1/4	>1/4	–
	Convalescent	1/128	<1/270	1/4	>1/4	–
MAC	Acute	1/16	1/25	ND	ND	–
	Convalescent	1/64	1/180	ND	ND	–
LIN	Acute	1/32	1/60	1/16	1/15	–
	Convalescent	1/512	<1/270	1/16	1/15	–
PIC	Acute	1/32	1/25	1/32	1/75	–
	Convalescent	1/1.024	<1/270	1/32	1/75	–
RIC	Acute	1/64	1/60	ND	ND	–
	Convalescent	1/512	<1/270	ND	ND	–
MIL	Acute	1/64	1/6	1/16	1/20	–
	Convalescent	1/256	<1/270	1/16	1/20	–
ELL	Acute	1/64	1/60	ND	ND	–
	Convalescent	1/1,024	<1/270	ND	ND	–

TABLE VII

CORRELATION BETWEEN TITRES OBTAINED BY THE INHIBITION OF AGGLUTINATION AND IN THE MOUSE

Influenzal infection not due to viruses A or B

Name	Time of bleeding	A virus		B virus		Agglutination in serum + normal fluid
		Inhibition of Agglutination	Tests in mice	Inhibition of Agglutination	Tests in mice	
RAL	Acute.....	1/4	1/6	1/8	1/15	–
	Convalescent.....	1/4	1/6	1/8	1/8	–
MILN	Acute.....	1/4	1/8	1/8	1/20	–
	Convalescent.....	1/4	1/8	1/4	1/20	–
HAM	Acute.....	1/4	1/8	1/8	1/15	–
	Convalescent.....	1/4	1/15	1/8	1/30	–
DAL	Acute.....	1/8	1/20	1/64	1/30	–
	Convalescent.....	1/8	1/20	1/32	1/30	–
HUS	Acute.....	1/32	1/180	ND	1/10	–
	Convalescent.....	1/32	1/75	ND	1/10	–
O'DE	Acute.....	1/64	1/180	1/32	1/7	–
	Convalescent.....	1/64	1/225	1/32	1/20	–
TRU	Acute.....	1/128	1/60	1/4	1/7	–
	Convalescent.....	1/128	1/60	1/4	1/7	–

TABLE VIII

CORRELATION BETWEEN TITRES OBTAINED BY THE INHIBITION OF AGGLUTINATION AND IN THE MOUSE. SERA TAKEN BEFORE AND 14 DAYS AFTER ONE DOSE OF INFLUENZA VACCINE

Name	Time of bleeding	A virus		Agglutination in serum + normal fluid
		Inhibition of Agglutination	Tests in mice	
COR	Before	1/8	1/25	–
	After	1/64	$<$1/270	–
CRA	Before	1/16	1/45	—
	After	1/16	1/75	–
McV	Before	1/32	1/15	–
	After	1/64	1/180	–
BAH	Before	1/32	1/25	–
	After	1/128	$<$1/270	–
WIS	Before	1/32	$<$1/270	–
	After	1/64	$<$1/270	–
HAR	Before	1/512	$<$1/270	–
	After	1/512	$<$1/270	–

It is clear from these estimations that the new test is capable of detecting an increase of antibody level in human serum provided it is of fairly large dimensions. The correlation between the two methods of testing was on the whole good. There were discrepancies, but there is little doubt that the test could be used to indicate broad differences. This is well brought out by consideration of the cases known to have been infected with influenza A virus. The average titre by the agglutination method (counting cases with a titre $>$ ¼ as ½) of the acute phase sera was 1/28.1 but of the convalescent sera it was 1/440.0. From the available data it is not possible to say that the antibody

being measured is the same as that in the mouse tests, but it would seem highly probable that it is.

No sera from cases or ferrets infected with B virus were available. Beyond the fact that there appears to be some correlation between the titres obtained in the *in vitro* tests and those using mice, it is not possible to say how valuable the test might be with this virus.

NEUTRALIZATION TESTS WITH FERRET SERA

No difficulties were encountered in employing the new method for the demonstration of neutralizing antibodies in the sera of ferrets. Of six normal ferrets tested, three had a titre of $> \frac{1}{4}$, one had $\frac{1}{4}$ and two $\frac{1}{8}$. Convalescent sera from animals which had suffered from an infection with PR8 or WS viruses had a much higher titre. Of eight sets of pooled sera, four had a titre of 1/256, two of 1/128 and two of 1/32.

DISCUSSION AND SUMMARY

These experiments show that when red cells of certain species are added to allantoic fluid containing either influenza A or influenza B virus, prompt agglutination of the cells occurs. This agglutination is presumably related to the fact that there is well-marked adsorption of the virus to the cells, but comparative studies will be necessary to determine why the cells of certain species are not agglutinable by influenza virus and to elucidate the relationship between adsorption and the agglutination of susceptible cells.

The adsorption and agglutination effects are of interest in view of their possible applications. As shown by the centrifugation experiments, the virus retains its infectivity when adsorbed on red cells. The degree of adsorption is significant, being 99 per cent or more, and suggests that a red cell adsorption method may be of value in concentrating or purifying the virus from suspensions. Sera containing influenza antibodies decrease the agglutinating effect of infected allantoic fluid and it has been shown that this antibody effect can be measured by a relatively simple and rapid method. This method is capable of detecting increases of antibody level if they are of sufficient extent and thus it may permit examination of larger numbers of serum samples from convalescent cases or vaccinated individuals than is possible using the mouse neutralization test.

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